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ACCU-LABS RESEARCH, INC.

11485 West 48th Avenue - Wheat Ridge, CO 80033 - (303) 423-2766

A N A L Y S I S R E P O R T

DATE: 08/31/90 PAGE 1

LAURIE J. JACOBSON
TALLEY DEFENSE SYSTEMS
P.O. BOX 849
3500 NORTH GREENFIELD ROAD
MESA, AZ 85211

Lab Job Number: 9879-35113-1
Date Samples Received: 08/13/90
Customer PO Number: 53765

These samples to be disposed of 30 days after the date of this report.

ALR Designation - 9879-35113-1-1
Sponsor Designation - TDS BG-8/7/90-LJ-2 TDS Pit Ash
Date Collected -

Determinations in mg/L unless noted

Silver-TCLP	<0.02
Arsenic-TCLP	<0.05
Barium-TCLP	0.48
Cadmium-TCLP	0.23
Chromium-TCLP	0.08
Mercury-TCLP	<0.001
Lead-TCLP	1.0
Selenium-TCLP	<0.05

By: Wendell D. Fischer
Wendell D. Fischer
Soils/RCRA Supervisor

WDF/dh

SCS ANALYTICAL LABORATORY
2860 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-9324
FAX (213) 595-6709

Sample I.D.: TDS-BG-6/29/90-LJ-3-pit 5 TDS
Date Received: 8/6/90
Date Analyzed: 8/10/90
Matrix: Water
Project: 689044
File #: tally9.rep

Compound	EPA Number	Result -----mg/L	D.L (ppm)-----
Arsenic	7060	ND	0.02
Barium	7080	0.21	0.08
Cadmium	7130	ND	0.01
Chromium	7160	ND	0.05
Lead	7420	ND	0.5
Mercury	7471	ND	0.002
Selenium	7740	ND	0.01
Silver	7760	ND	0.02

ND = Not Detected
D.L. = Detection Limit

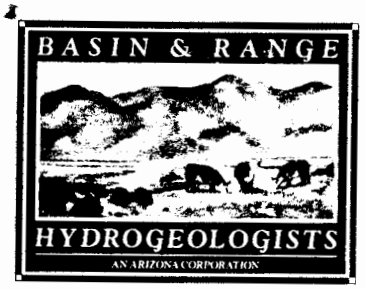
SCS
ANALYTICAL
LABORATORY

2660 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-9324
FAX (213) 595-6729

Sample I.D.: TDS-BG-8/7/90-LJ-1 TDS Pit Ash
Date Received: 8/9/90
Date Analyzed: 8/21/90
Matrix: Solid
Project: 689044
File #: tally10.rep

Compound	EPA Number	Result -----mg/L	D.L (ppm)-----
Arsenic	7060	ND	0.02
Barium	7080	0.27	0.08
Cadmium	7130	ND	0.01
Chromium	7160	0.16	0.05
Lead	7420	ND	0.5
Mercury	7471	0.004	0.002
Selenium	7740	ND	0.01
Silver	7760	ND	0.02

ND = Not Detected
D.L. = Detection Limit



DL/QA

PRIVILEGED & CONFIDENTIAL -- PREPARED AT THE DIRECTION OF LEGAL COUNSEL

SITE ASSESSMENT PLAN
TALLEY DEFENSE SYSTEMS'
WATER BORE-OUT PITS

Prepared for

KIMBALL & CURRY, P.C.
2600 North Central Avenue, Suite 1600
Phoenix, Arizona 85004

Prepared by

BASIN & RANGE HYDROGEOLOGISTS, INC.
5080 North 40th Street, Suite 105
Phoenix, Arizona 85018

December 4, 1991

TALLEY DEFENSE SYSTEMS | Talley Industries
REFER TO: LJJ-2371

September 16, 1992

Frances Schultz
EPA Region IX
Mail Code H-2-2
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Shultz:

At the request of Mary Wesling (SAIC) I am sending you the following documents:

1. Site Assessment Plan (SAP) for the Plant 3 Water Bore Out Area; and

2. The SAP for the Thermal Treatment Unit.

These documents are currently under review by the Arizona Department of Environmental Quality. If you have any questions, please feel free to call me at 602/898-2433.

Sincerely,

TALLEY DEFENSE SYSTEMS, INC.

Laurie J. Jacobson

Laurie J. Jacobson
Environmental Quality and
Health Specialist

LJJ/pnk
Enclosure

cc: Mary Wesling, SAIC
20 California St., Suite 400
San Francisco, CA 94111

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1.0 INTRODUCTION

BASIN & RANGE HYDROGEOLOGISTS, INC. (BASIN & RANGE) was retained by Kimball & Curry, P.C. (K&C) on behalf of its client, Talley Defense Systems (Talley), to prepare a Site Assessment Plan (SAP) for the water bore-out pits at Talley's Mesa facility. Talley and the State of Arizona, represented by Arizona Department of Environmental Quality (ADEQ) and the Arizona Attorney General, executed a Consent Judgment on September 6, 1991, requiring that an SAP be submitted to ADEQ within 90 days of the effective date of the Consent Judgment. The purpose of the SAP, as stated in the Consent Judgment, is to "***provide for the development of information sufficient to determine the presence and lateral and vertical extent of contamination from hazardous waste or hazardous waste constituents at the bore-out pits . . ..***"

This SAP contains descriptions of the water bore-out pits and the rationale used to develop the sampling program, as well as the field sampling procedures, analytical methods, quality assurance procedures, and health and safety plan to be followed during implementation of the SAP. The SAP was prepared by BASIN & RANGE in general accordance with the SAP outline referenced as "Attachment C" in Paragraph 14 of the Consent Judgment.

1.1 SITE CHARACTERIZATION

1.1.1 Site Description

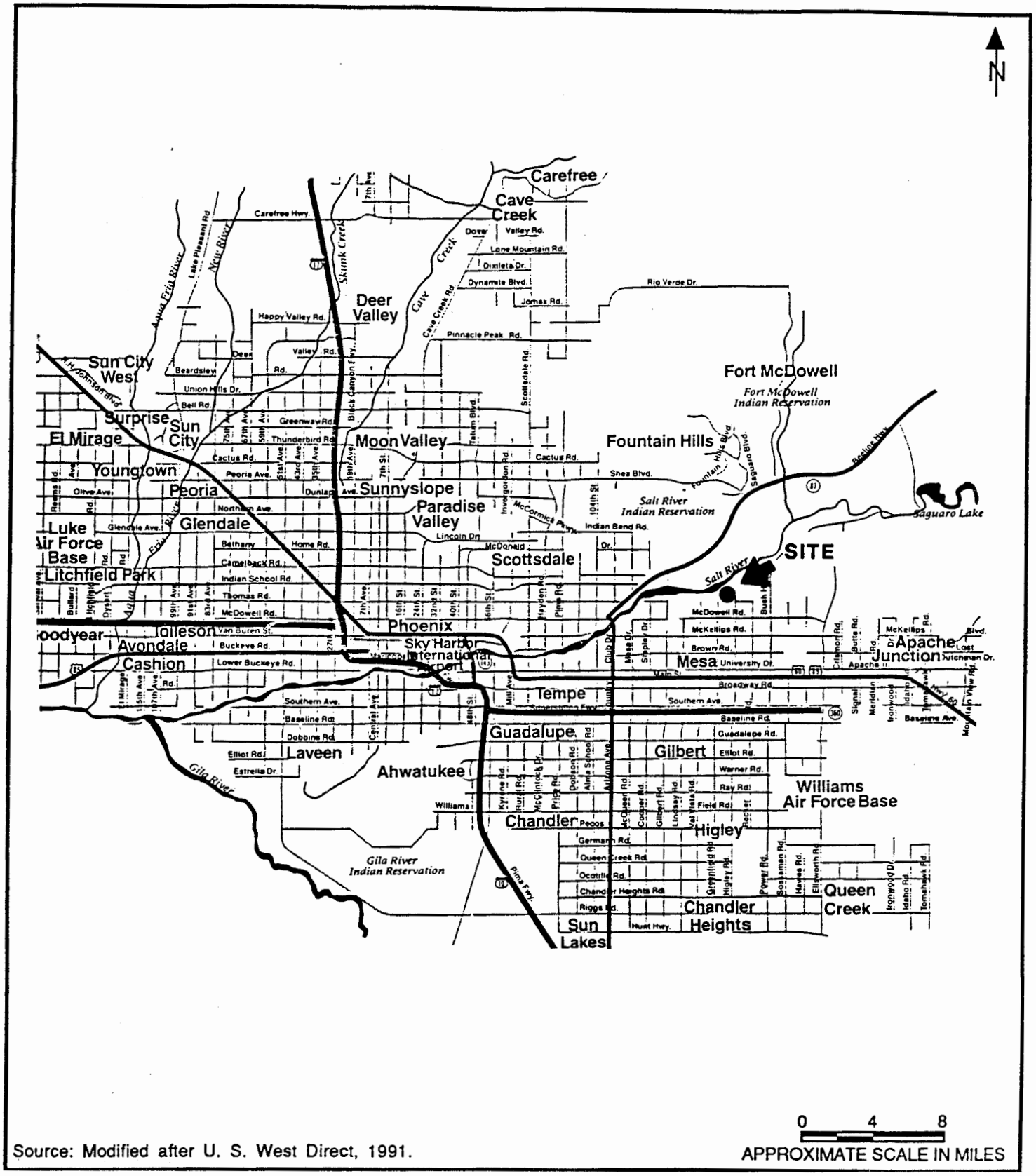
Talley is an aerospace company that, in general, designs, develops, and manufactures aircraft escape rocket motors and rocket catapults for emergency escape and survival systems, including the required propellants. In addition, Talley manufactures gas generators and has manufactured propellants for automotive air bag inflators. Rocket motors which required service formerly were bored out using a high-pressure water nozzle to disintegrate the solid propellant, liner, and boot. Water and suspended solids (i.e., very fine-grained materials) generated by that process were collected in the water bore-out pits.

Talley's facilities are located approximately 20 miles east-northeast of downtown Phoenix in the northeast part of the City of Mesa, Arizona (*Exhibit 1-1*). The water bore-out pits are located at Plant No. 3, southwest of Plant No. 4, and approximately 1.5 miles northeast of the intersection of East McDowell Road and North Greenfield Road (*Exhibit 1-2*). The water bore-out pits occupy a rectangular-shaped area, approximately 61 feet in length by 55 feet in width, which is surrounded by earthen berms (*Exhibit 1-3*). The berms are approximately 5 feet in height and consist of soil that was graded from the site during construction of the pits. The width of the berms ranges from approximately 7.5 feet to 10 feet. As shown on *Exhibit 1-3*, a berm subdivides the area into two pits, referred to as water bore-out Pit 1 and water bore-out Pit 2. The interior of each pit is approximately 45 feet in length and 12 feet in width. Water bore-out operations were formerly conducted in a concrete building located approximately 210 feet northwest of the water bore-out pits. Water and suspended solids were delivered to the pits via a concrete trough which is approximately 1.5 feet in width and 0.5 feet in depth (*Exhibit 1-3*).

In addition to Talley's general plant security provisions, the water bore-out operations building, concrete trough, and water bore-out pits are surrounded by a temporary, 6-foot high, chain-link fence topped with three strands of barbed wire to prevent unauthorized and unknowing entry (*Exhibit 1-3*). Additionally, the water bore-out area is located within the fence surrounding Plant #3 (*Exhibit 1-2*). Entry to the water bore-out area is controlled by primary and secondary gates which are always locked except when authorized personnel are present. The primary gate is located at the entrance to Plant #3 and serves as an effective barricade to the road leading to the water bore-out area. The secondary gates barricade entrance to the water bore-out area and are located along the temporary fence adjacent to the water bore-out operations building and the pits (*Exhibit 1-3*). Keys to the gates and access are strictly controlled. No persons are allowed to enter the water bore-out area without prior authorization and appropriate identification badges.

1.1.2 Environmental Setting

The water bore-out pits are situated on a dissected alluvial terrace (*TRC, 1988*) at an elevation of approximately 1,340 feet above mean sea level. The water bore-out



Source: Modified after U. S. West Direct, 1991.

Figure 2-1: (Source: d:1-3)

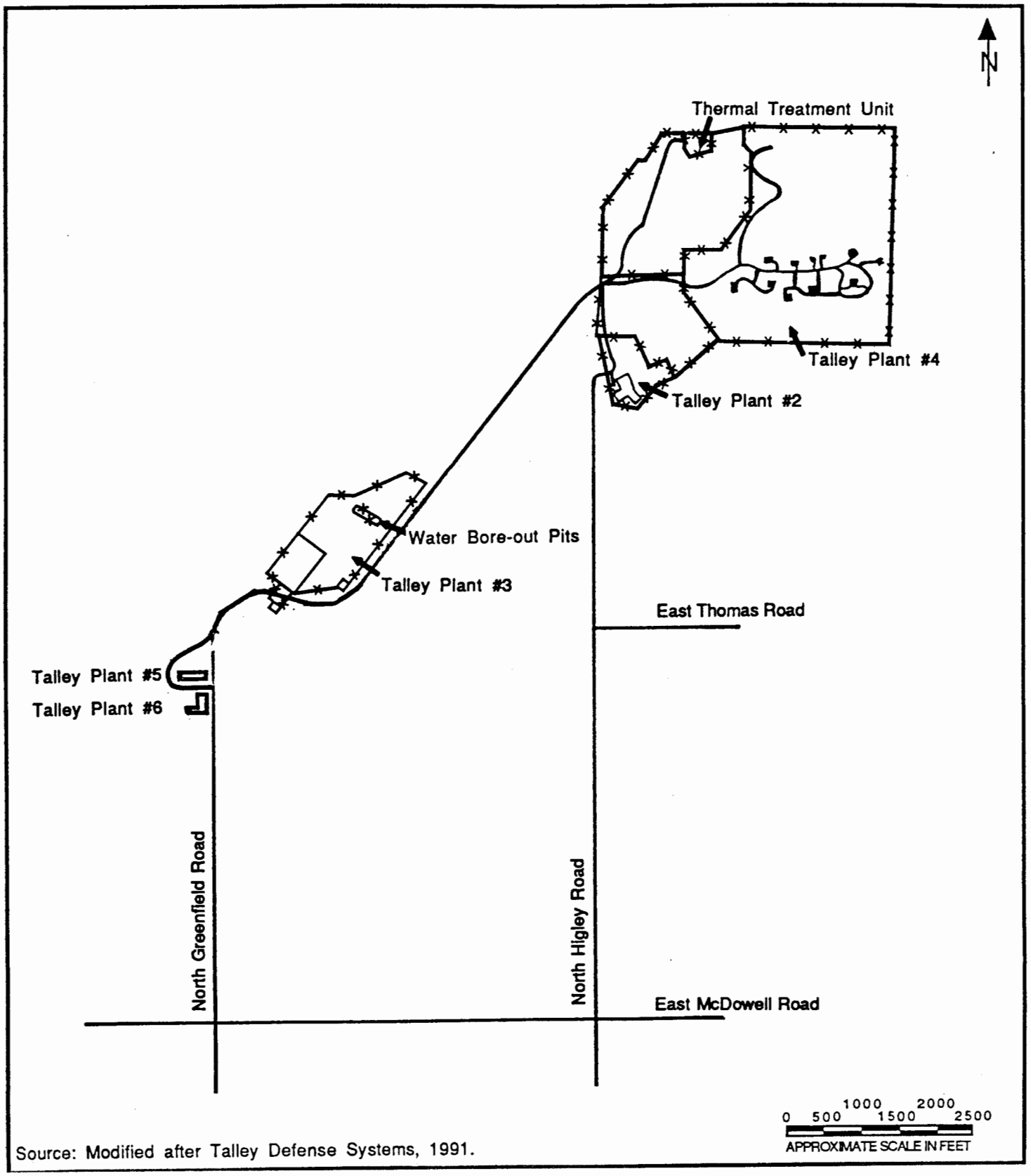


Figure 2-2: Specific Site Location Map (Source: d:1-4)

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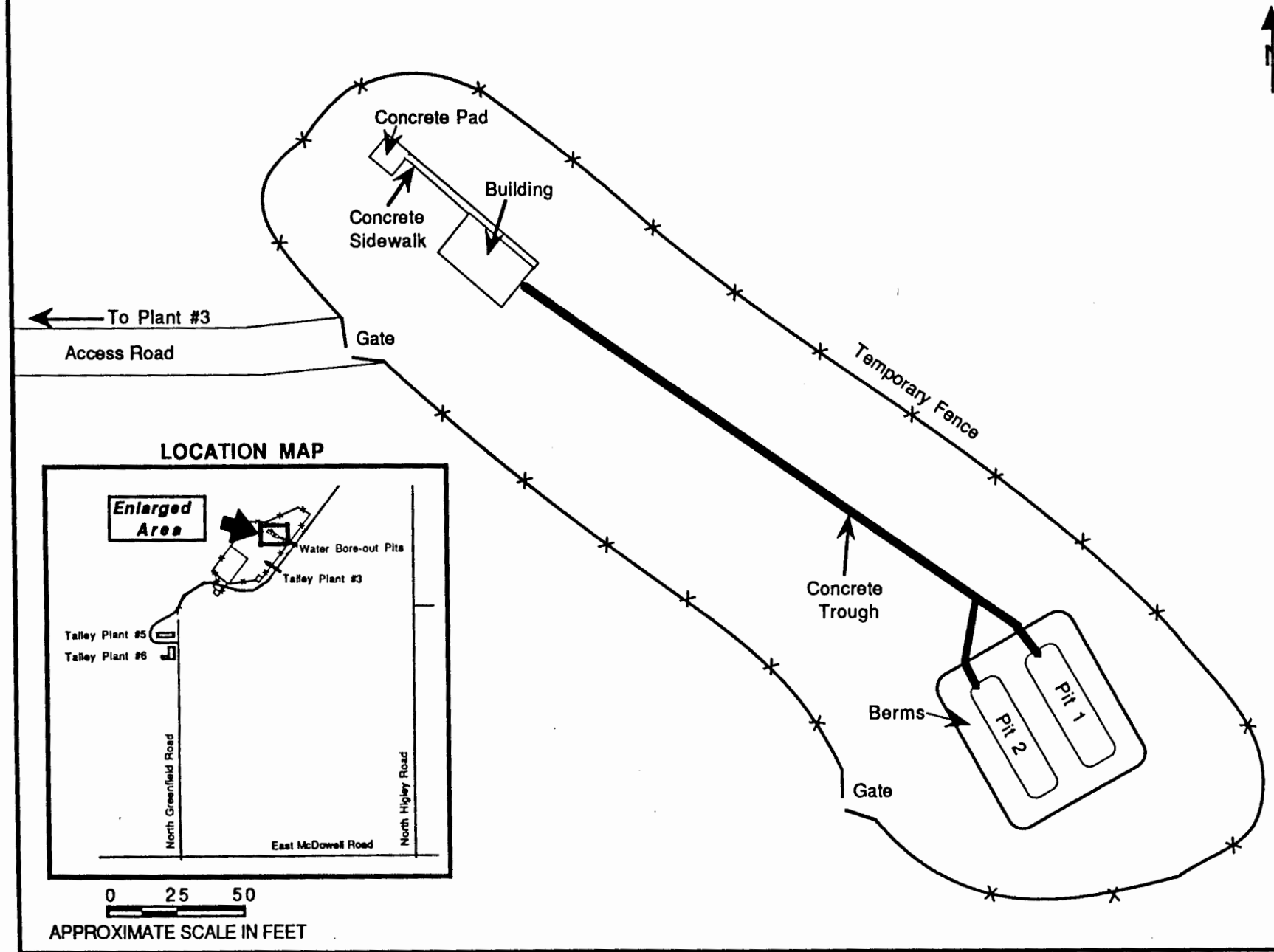


BASIN & RANGE HYDROGEOLOGISTS, INC., PHOENIX, ARIZONA		WATER BORE-OUT PITS SITE PLAN TALLEY DEFENSE SYSTEMS MESA, ARIZONA	EXHIBIT 1 - 3
DATE: DECEMBER 4, 1991	FILE NO.: 91-108-001		

operations building is situated at the top of a small hill, approximately 10 to 15 feet higher in elevation than the pits. A concrete trough extends down the side of the hill from the operations building to the pits. The site generally slopes to the southeast. The predominant wind direction is to the northeast.

Talley's facilities lie within the Basin and Range Physiographic Province, which is dominated by a series of northwest-trending mountain ranges and alluvial valleys containing thousands of feet of unconsolidated sediments (*TRC, 1988*). The Province was formed during Middle Tertiary time and evolved as a result of complex structural movements and associated erosional and depositional events (*Arizona Geological Society, 1987*).

The water bore-out pits are situated on alluvium that overlies Precambrian, basement-type, granitic rocks on the eastern edge of the East Salt River Valley Ground-water Basin of the Salt River Valley (*Laney and Hahn, 1986*). The Usery Mountains, located northeast of Talley, are predominantly comprised of the Ruin Granite, a quartz monzonite of Precambrian age (*TETC, 1988*). This granite comprises the basement complex in the vicinity of Talley and outcrops are exposed approximately 1 mile northeast of the site. The East Salt River Valley Ground-water Basin is comprised of heterogeneous alluvial deposits that overlie the basement complex and the surrounding mountain-fronts from which the sediments were eroded. The sedimentary units (alluvium) generally increase in thickness to the west and southwest of Talley's site. The thickness of alluvium beneath the site ranges from approximately 600 to 800 feet (*SRP, 1988*).

Late Tertiary and Quaternary valley-fill deposits occur beneath the water bore-out pits. The alluvial deposits consist of unconsolidated and poorly consolidated clay, sand, and gravel (*TETC, 1988*). The alluvial deposits in the area are divided into the Upper Alluvial Unit and the Lower Conglomerate Unit; the Middle Fine-grained Unit reportedly is not present (*TETC, 1988*). The Upper Alluvial Unit is comprised predominantly of unconsolidated silts, sands, and gravels, having a thickness ranging from 265 to 685 feet in the vicinity of Talley. The Upper Alluvial Unit forms the major aquifer in that area, and ground water within the unit generally is found under unconfined conditions. The Upper Alluvial Unit directly overlies the Lower

Conglomerate Unit, which varies in thickness from approximately 100 to approximately 125 feet (*TETC, 1988*). The Lower Conglomerate Unit overlies the granitic basement rock at depths of 650 to 850 feet and is a source of ground water in the vicinity of Talley (*TETC, 1988*).

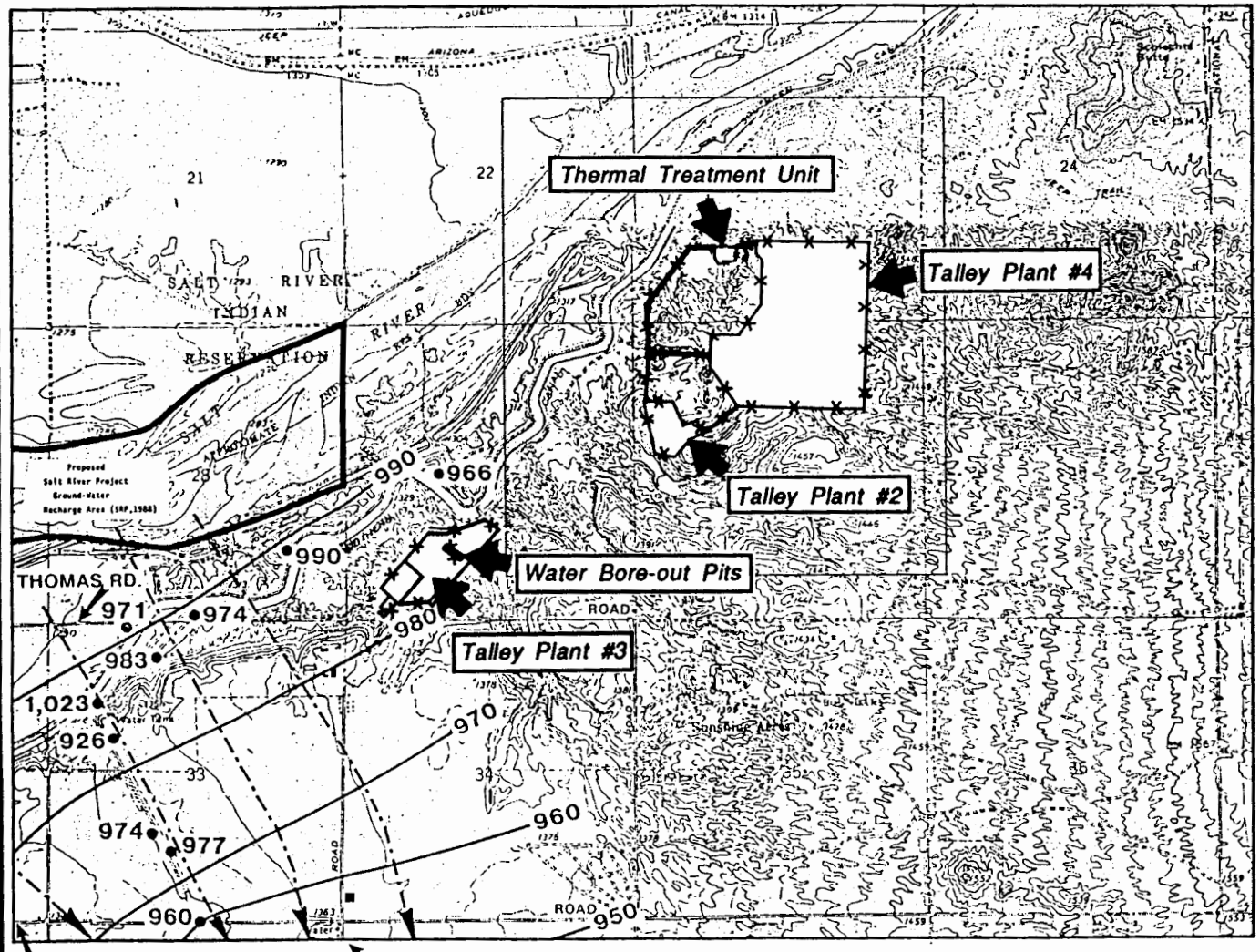
Ground water from the regional alluvial deposits is developed for irrigation, industrial, and municipal supply purposes. Two water wells exist within approximately one-half mile of the water bore-out pits (*Exhibit 1-4*). As shown on the ground-water elevation contour map presented in *Exhibit 1-4*, Salt River Project (SRP) (1988) interpreted the direction of regional ground-water flow to be southeast, toward a pumping cone of depression located south of Falcon Field. The regional water levels shown on *Exhibit 1-4* were measured during the winter of 1984-85 (*SRP, 1988*). BASIN & RANGE has reviewed regional water-level data and, based on its interpretations, believes that the depth to ground water in the regional alluvium ranges from about 300 to 500 feet below ground surface.

1.1.3 Adjacent Land Use

The water bore-out pits are located in a remote part of the City of Mesa. In the immediate vicinity of the water bore-out pits, land has been used primarily as "*open range*," although industrial areas (including Talley's facilities), agricultural land, and sand and gravel operations are located within approximately one-half mile of the site (*Exhibit 1-5*). No population centers are located in the immediate vicinity of the water bore-out pits; however, a residential community is located approximately 0.75 miles east of the site.

1.2 BACKGROUND

Discussions regarding chemical usage, handling, storage, treatment and disposal practices, as well as waste management practices, are provided in the following sections. Additionally, summaries of previous sampling and analysis investigations and a state "superfund" investigation are provided below.



BASE MAP: U.S. G.S. 7-1/2 MINUTE SERIES - GRANITE REEF AND BUCKHORN QUADRANGLES, 1982.

N

EXPLANATION

990• Measured well and water-level elevation in feet above mean sea level

920 Water-level elevation contour in feet above mean sea level as interpreted by SRP, 1988

Direction of ground-water flow

0 2000 4000
APPROXIMATE SCALE IN FEET

Source: Modified after Salt River Project, 1988.

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BASIN & RANGE HYDROGEOLOGISTS, INC., PHOENIX, ARIZONA		GROUND-WATER ELEVATION CONTOUR MAP IN THE VICINITY OF TALLEY DEFENSE SYSTEMS MESA, ARIZONA	EXHIBIT 1 - 4
DATE: DECEMBER 4, 1991	FILE NO.: 91-108-001		

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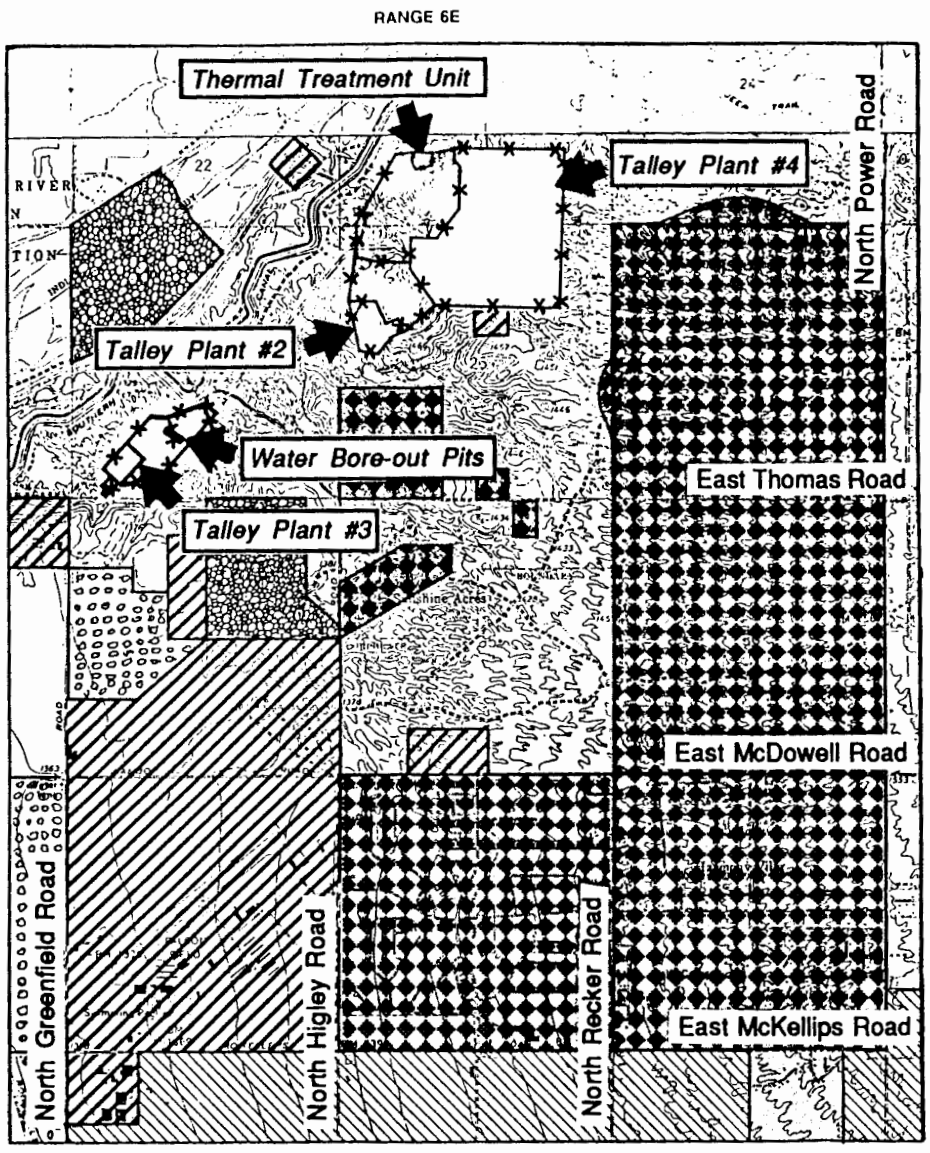


BASE MAP SOURCE: U.S. GEOLOGICAL SURVEY, 7-1/2 MINUTE SERIES
GRANITE REEF AND BUCKHORN QUADRANGLES, 1982

Source: Modified after Basin & Range Hydrogeologists, Inc., 1988.

BASIN & RANGE HYDROGEOLOGISTS, INC., PHOENIX, ARIZONA		GENERALIZED LAND USE MAP IN VICINITY OF TALLEY DEFENSE SYSTEMS MESA, ARIZONA	EXHIBIT 1 - 5
DATE: DECEMBER 4, 1991	FILE NO.: 91-108-001		

1.2.1 Chemical Usage, Handling, Storage, Treatment, and Disposal Practices

The types of propellants bored out by Talley at the water bore-out operations area are grouped into the following two categories:

- Ammonium perchlorate propellant
- Ammonium nitrate propellant.

In general, components of those propellants include oxidizers, binders and polymers, plasticizers, combustion modifiers, metals, and other minor ingredients. A list of the chemical compounds typically used in each of the two propellant categories is provided in *Appendix A*.

Rocket motors, which required service, formerly were transported to the water bore-out operations building to be bored out using an automated high pressure water nozzle. The water bore-out equipment was capable of processing one motor at a time and was used primarily for rocket motors containing ammonium perchlorate propellants. Additionally, rocket motors containing ammonium nitrate propellants were occasionally bored out at the site. At the water bore-out operations building, the rocket motors were placed in a closed cabinet containing dual rollers and a drive motor. The drive motor and rollers were used to rotate the rocket motor while water from the high pressure nozzle disintegrated the solid propellant, liner, and boot. The high pressure water nozzle was bracketed to a leadscrew and a second drive motor which were used to traverse the water nozzle through the rocket motor.

Water and solids bored out of the rocket motors flowed out the bottom of the closed cabinet into a screened metal container. Most of the solids were collected on the screen or settled to the bottom of the container. The water flowed into a concrete trough in the floor of the building and into a second, 55-gallon container where additional solids were removed from the water by settling. The water and any remaining suspended solids from the water bore-out operation flowed out of the second container and into the concrete trough leading to the water bore-out pits (*Exhibit 1-3*). Procedures for managing the solids generated by the water bore-out process are discussed below.

1.2.2 Waste Management Practices

At the request of ADEQ, Talley voluntarily ceased water bore-out operations at the facility in October, 1990. During approximately 1988 through October, 1990, solids collected in the settling container and screen, located beneath the closed cabinet in the water bore-out operations building, were removed while wet and temporarily accumulated at or near the point of generation in a 55-gallon drum. The secondary 55-gallon settling container, formerly located at the southeast end of the operations building, was removed after it contained a sufficient quantity of solids and replaced with an empty drum. Additionally, fine-grained solids which collected in the bottom of the water bore-out pits were removed while wet and placed in 55-gallon drums.

Drums containing solids generated as a result of Talley's water bore-out operations during June through October, 1990 were accumulated on site on the concrete pad located approximately 30 feet northwest of the water bore-out operations building (*Exhibit 1-3*). During approximately 1988 through May, 1990, drums containing water bore-out solids were transported to Talleys thermal treatment unit (TTU) and "*treated*," along with waste propellants generated as a result of Talley's manufacturing operations, by means of open burning. Talley adheres to comprehensive procedures for collection and burning of its waste at the TTU. Those procedures are presented in *Appendix B*.

Prior to approximately 1988, solids generated as a result of water bore-out operations were burned in the water bore-out pits. Solids collected in the settling containers were temporarily accumulated at or near the point of generation as described above. Prior to initiating a scheduled burn, those solids were collected and placed in one of the water bore-out pits, along with fine-grained solids which had accumulated in the bottom of that pit. Water from continued water bore-out operations was diverted into the adjacent pit, and the solids contained in the water bore-out pit selected for the burn were allowed to dry. After drying, the burn was initiated following the same general procedures used for the burning of waste propellants at the TTU.

1.2.3 Past Release/Spill History

BASIN & RANGE understands that the water bore-out pits were used solely for the management of wastes generated by the water bore-out operation, as described above. Talley has no knowledge of the occurrence of any other variety of release at the water bore-out pits.

1.2.4 Previous Soil Sampling and Analysis

Samples of site soils were collected by Talley at the water bore-out pits during 1990. Additionally, Talley collected samples of water bore-out solids accumulated on site in 55-gallon drums, as well as water used in the water bore-out process. The samples were analyzed for the leachable concentration of selected metals using the EP Toxicity Procedure or the Toxicity Characteristic Leaching Procedure (TCLP); total concentration of selected metals using the acid digestion preparation method; semi-volatile organic compounds using EPA Method 625; and ammonium perchlorate using a specific ion detection method. The results of those analyses are discussed below. Copies of the laboratory analytical reports are provided in *Appendix C*.

During February and August, 1990, Talley collected three samples of solids generated by the water bore-out process which were contained on site in 55-gallon drums. Those samples were analyzed for cadmium, chromium, and lead using the EP Toxicity Procedure (EPA Method 1310 - one sample) or the TCLP (EPA Method 1311 - two samples). The result of the EP Toxicity analysis indicated that cadmium was detected at a concentration of 0.55 milligrams per liter (mg/L) which is below the U.S. Environmental Protection Agency (EPA) maximum contamination concentration (MCC) of 1.0 mg/L for cadmium (*Appendix C-1*). Chromium and lead were not detected in the sample at concentrations equal to or exceeding the laboratory detection limit. The results of the TCLP analyses indicated that lead was detected in one sample at a concentration of 1.0 mg/L which is below the EPA MCC of 5 mg/L for lead (*Appendix C-2*). However, lead was not detected in the second sample, and chromium and cadmium were not detected in either sample at concentrations equal to or exceeding the laboratory detection limit.

Talley also collected a sample of water retained in the water bore-out pits during the February, 1990 sampling event. That sample was analyzed for cadmium, chromium, and lead using the EP Toxicity procedure, and cadmium was detected at a concentration of 0.11 mg/L, significantly below the EPA MCC of 1.0 mg/L for cadmium. Chromium and lead were not detected in the water sample at concentrations equal to or exceeding the laboratory detection limit.

During November, 1990, Talley collected eight soil samples from the water bore-out pits and two background soil samples to evaluate the possible impact of water bore-out operations on site soils. Those samples were collected at depths ranging from 0 to 3 feet below existing surface grade and analyzed for the total concentration of cadmium, chromium, lead, and nitrate using the acid digestion sample preparation method (EPA Method 3050). Talley's research laboratory also analyzed the samples for ammonium perchlorate using a specific ion detection method. The results of those analyses are summarized in *Table 1-1*. Copies of the laboratory analytical reports are provided in *Appendix C-3*.

Cadmium, chromium, lead, and nitrate were detected in the soil samples collected from the water bore-out pits at concentrations significantly below the draft health-based guidance levels (HBGL) for soil established for those compounds by ADEQ (1990) (*Table 1-1*). In general, the highest metal and nitrate concentrations were detected from 0 to 1 foot below existing surface grade and decreased significantly below that depth. Additionally, concentrations of cadmium, chromium, lead, and nitrate in soil samples collected from 0 to 2 feet below existing surface grade generally exceeded the concentrations detected in the background samples. Concentrations of ammonium perchlorate in the soil samples ranged from 105 to 18,000 milligrams per kilogram (mg/kg). A draft HBGL for that compound has not been established by ADEQ.

As part of a research project designed to evaluate alternative treatment options for water used in the water bore-out process, Talley collected a sample of water from a test of the water bore-out process conducted during December, 1990. Water used during that test was contained on site in 55-gallon drums. The sample was analyzed for semi-volatile organic compounds (EPA Method 625) and arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver (EPA Methods 206.2, 200.7,

TABLE 1-1. SUMMARY OF ANALYTICAL RESULTS FOR WATER BORE-OUT PIT SOIL SAMPLES COLLECTED DURING NOVEMBER, 1990

Location	Sample No.	Depth (ft)	Analytical Results (total concentration in mg/kg)				
			Ammonium Perchlorate	Cadmium	Chromium	Lead	Nitrate
Pit # 1	TDS3-11/9/90-LJ-1-1	0	4,400	<4 (1)	6	12	151
Pit # 1	TDS3-11/9/90-LJ-1-2	1	18,000	6	9	210	97
Pit # 1	TDS3-11/9/90-LJ-1-3	2	1,830	<4	3	39	64
Pit # 1	TDS3-11/9/90-LJ-1-4	3	615	<4	5	7	55
Pit # 2	TDS3-11/9/90-LJ-2-1	0	705	7	13	192	123
Pit # 2	TDS3-11/9/90-LJ-2-2	1	105	26	9	6	98
Pit # 2	TDS3-11/9/90-LJ-2-3	2	152	22	8	6	51
Pit # 2	TDS3-11/9/90-LJ-2-4	3	170	17	7	15	63
Background	TDS3-11/9/90-LJ-3-1	0	NA(2)	<4	7	12	32
Background	TDS3-11/9/90-LJ-3-2	1	NA	<4	7	6	19
ADEQ's Draft Health Based Guidance Level for Soil			NE(3)	100	2,000	400	200,000

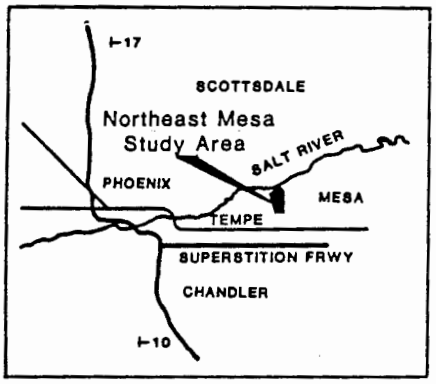
NOTES:
(1) Constituent not detected at the indicated detection limit
(2) NA - Not Analyzed
(3) NE - Not Established

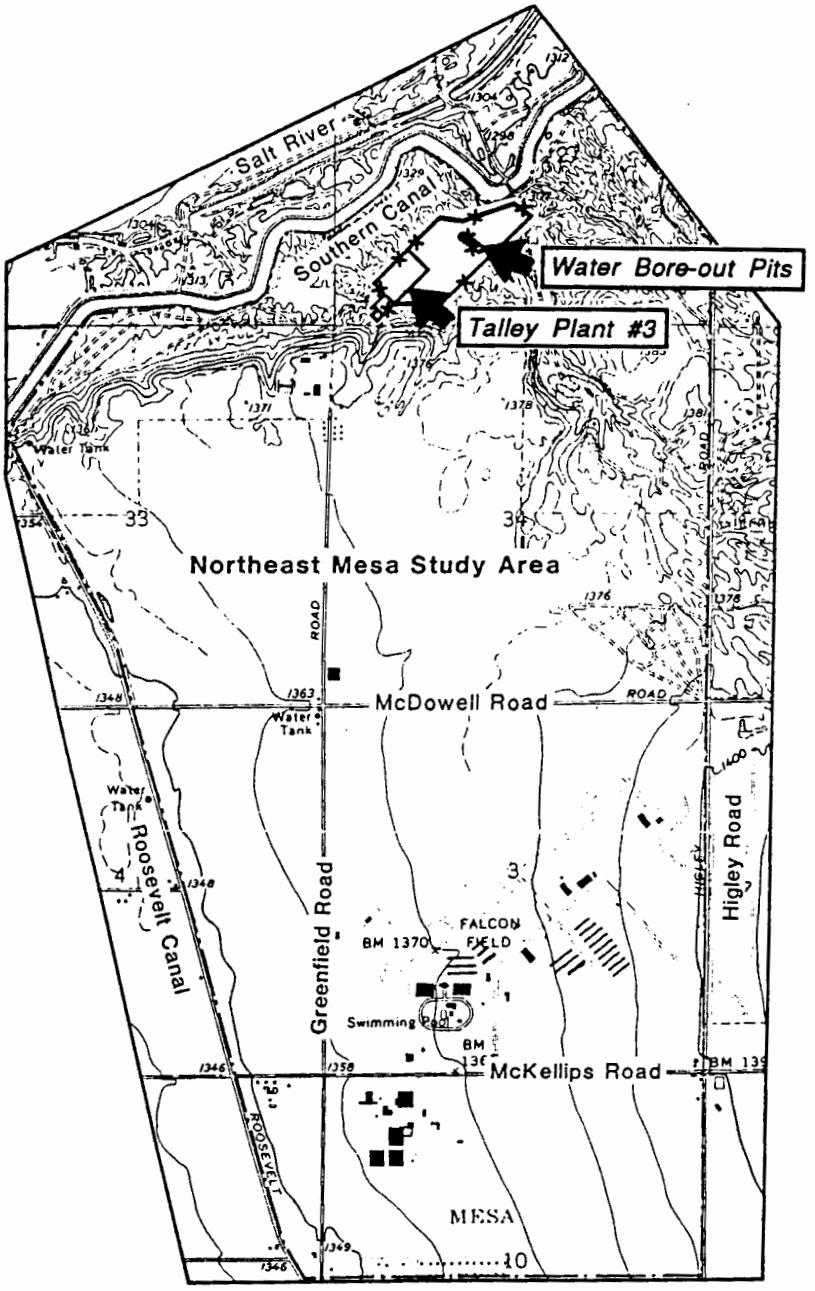
245.1, and 270.2, respectively) (*Appendix C-4*). Laboratory analytical results incidated that semi-volatile organic compounds and metals were not detected in the water sample at concentrations equal to or exceeding the laboratory detection limit.

1.2.5 Northeast Mesa Water Quality Assurance Revolving Fund Investigation

During 1988, ADEQ initiated a preliminary remedial investigation to assess the nature, extent, and potential sources of volatile organic compounds (i.e., trichloroethylene and 1,1-dichloroethylene) detected in ground-water samples collected from one irrigation well within the Northeast Mesa Water Quality Assurance Revolving Fund (WQARF) study area. The study area extends from the Southern Canal on the north to one-half mile south of McKellips Road, and is bounded by Higley Road on the east and the Roosevelt Canal on the west (*Exhibit 1-6*). Talley's water bore-out pits are located within the boundaries of the Northeast Mesa WQARF study area, as shown on *Exhibit 1-6*.

During ADEQ's Phase I investigation, literature and records research, downhole geophysical logging, and ground-water sampling and analysis were performed by ADEQ's consultant, The Earth Technology Corporation. The Earth Technology Corporation (1988) concluded that it was not possible to prioritize the potential sources of ground-water contamination in the study area because sufficient data were not available for such an analysis. Additionally, Talley has not been identified by ADEQ as a responsible party for the ground-water contamination detected in the Northeast Mesa study area. BASIN & RANGE understands that a Phase II WQARF investigation has not been conducted for the Northeast Mesa study area.





0 1000 2000 3000 4000 5000
APPROXIMATE SCALE IN FEET

Source: Modified after The Earth Technology Corporation, 1988.

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	NORTHEAST MESA STUDY AREA	EXHIBIT 1 - 6
FILE NO.: 91-108-001	BASIN & RANGE	DATE: DECEMBER 4, 1991

2.0 SAMPLING INVESTIGATION

The following sections include discussions regarding the rationale for soil sampling, descriptions of analytical methods and field procedures, qualifications of sampling and analytical personnel, and notification of ADEQ.

2.1 RATIONALE FOR SAMPLING

The sampling rationale is based on information provided by Talley regarding its water bore-out operations and the analytical results derived from previous sampling at Talley's water bore-out pits. Based on the composition of typical ammonium perchlorate and ammonium nitrate propellants disintegrated during the water bore-out process, as well as previous investigations conducted at the site, potential contamination by hazardous waste or hazardous waste constituents (if any) at Talley's water bore-out pits is expected to be restricted to the upper 3 feet of site soil and comprised primarily of heavy metals. Ammonium perchlorate also has been detected at a wide range of concentrations in soil samples collected at the water bore-out pits. Therefore, the proposed sampling efforts at the water bore-out pits will be focused on site soils within the upper 20 feet.

Although previous samples have been collected at this site and analyzed for the presence of the same analytes to be tested during this sampling program, little information is available regarding the distribution of those analytes in soil at the water bore-out pits. Based on our understanding of the activities conducted at the water bore-out pits, and because of the method of sample collection chosen for the site assessment (i.e., drilling), an authoritative sampling strategy will be implemented. The primary objective of that sampling strategy is to collect representative samples of the soil in sufficient quantities to provide estimates of the average chemical properties (i.e., for specific analytes) of the soils. Site-specific information regarding the exact locations and numbers of samples to be collected at the water bore-out pits, as well as the selected analyses, are discussed below.

2.1.1 Sampling Locations and Depths

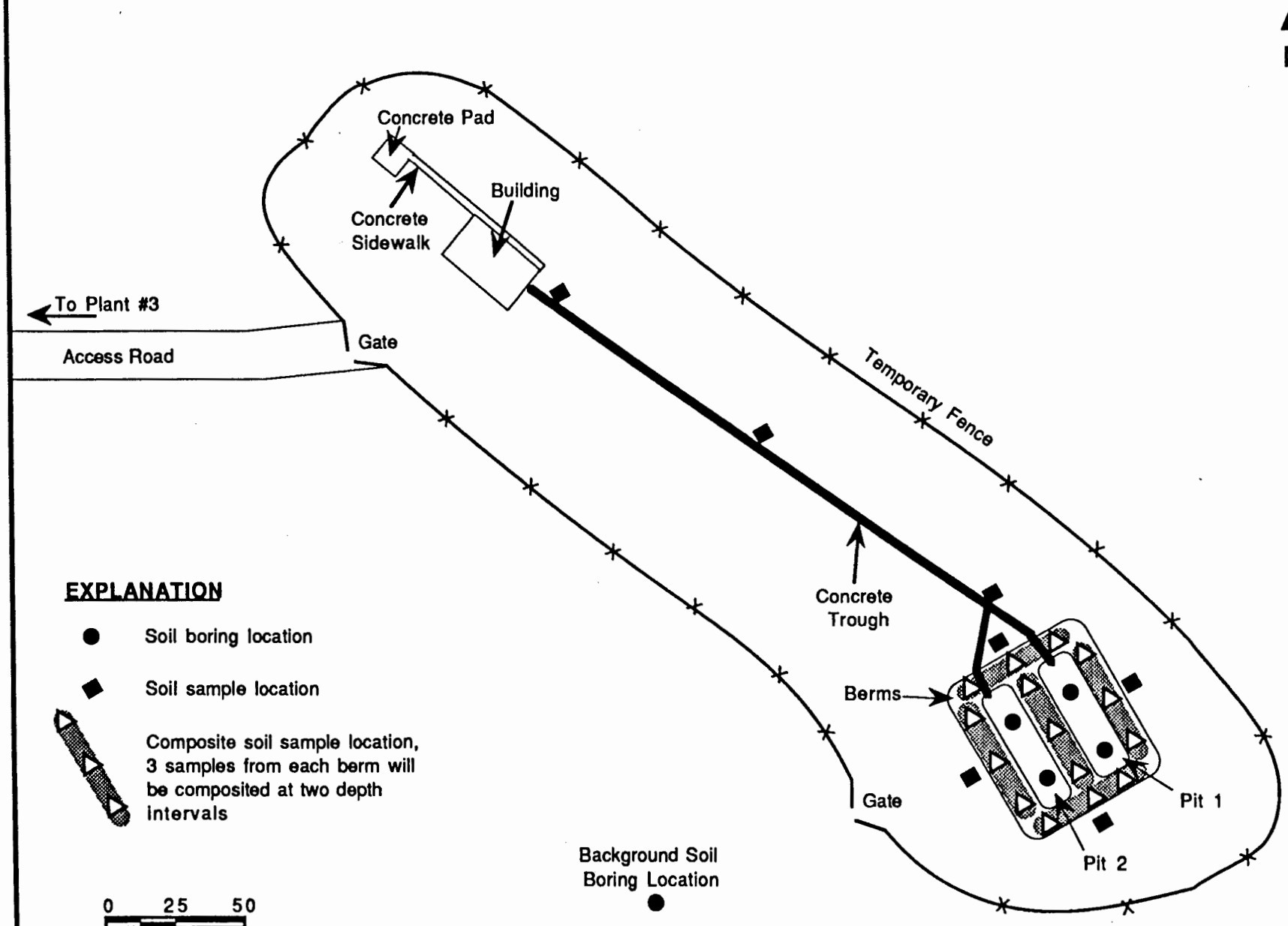
Sampling will be conducted within each of the water bore-out pits (described in Section 1.1.1 and depicted in *Exhibit 2-1*) to evaluate the type and concentration (if any) of the analytes to be tested during this sampling program (i.e., selected hazardous waste or hazardous waste constituents, as well as ammonium perchlorate) in the soil. Additionally, soil samples will be collected from the earthen berms surrounding the pits to assess possible contamination of those containment structures (*Exhibit 2-1*). The vertical extent of possible contamination in each pit and the potential downward migration of the analytes into underlying alluvium will be evaluated by collecting soil samples at 2.5- and 5-foot depth intervals to a maximum depth of 20 feet below existing surface grade. Those samples will be collected at two locations beneath the base of each water bore-out pit (*Exhibit 2-1*). In addition, near-surface soil samples (i.e., from about 0 to 2 and 6 to 12 inches below existing surface grade) will be collected from the earthen berms and the area immediately surrounding the pits to assess whether those soils have been impacted by water bore-out operations. Near-surface soil samples (i.e., from about 0 to 2 and 6 to 12 inches below existing surface grade) also will be collected from three locations beneath joints in the concrete trough leading from the water bore-out operations building to the pits (*Exhibit 2-1*).

To evaluate background concentrations of appropriate metals and ammonium perchlorate in native soils, a soil boring will be drilled and samples will be collected at 2.5- and 5-foot depth intervals to a maximum of 20 feet. The background sample location will be located approximately 100 feet southwest of the water bore-out pits on the outside of the temporary fence (*Exhibit 2-1*). As shown on *Table 2-1*, a total of 66 samples, including duplicate and background samples, field, travel and equipment blanks, will be collected during the sampling program. Specific information regarding the number of samples is described below.

2.1.2 Rationale for Number of Samples

During previous sampling conducted by Talley during 1990, various chemical analyses were performed on soil, solids, and water samples collected from the water

BASIN & RANGE



BASIN & RANGE HYDROGEOLOGISTS, INC., PHOENIX, ARIZONA	SAMPLE LOCATION MAP WATER BORE-OUT PITS TALLEY DEFENSE SYSTEMS MESA, ARIZONA	EXHIBIT 2 - 1
DATE: DECEMBER 4, 1991 / FILE NO.: 91-108-001		

TABLE 2-1. SAMPLES PROPOSED FOR ASSESSMENT OF THE WATER BORE-OUT PITS

	Depth Interval (feet below grade)							Total
	0	0.5	2.5	5	10	15	20	
Bore-out Pits	4	0	4	4	4	4	4	24
Berms	5	5	0	0	0	0	0	10
Surrounding Area	4	4	0	0	0	0	0	8
Trough Joints	3	3	0	0	0	0	0	6
Duplicates	5	0	0	0	0	0	0	5
Background	1	1	1	1	1	1	1	7
Blanks								
Field	NA	NA	NA	NA	NA	NA	NA	2
Equipment	NA	NA	NA	NA	NA	NA	NA	2
Trip	NA	NA	NA	NA	NA	NA	NA	2
Total	**22**	**13**	**5**	**5**	**5**	**5**	**5**	**66**

bore-out pits. However, no sampling has been performed in the pit berms, the soil surrounding the pits, or along the concrete trough used to deliver water to the pits. Therefore, BASIN & RANGE will collect samples from selected locations within each water bore-out pit to confirm the results from previous analyses, as well as selected locations in the pit berms, surrounding soil, and along the concrete trough to assess possible contamination of those areas which were not sampled during previous sampling efforts. Authoritative sampling techniques were used to select the location of two soil borings within each water bore-out pit (*Exhibit 2-1*). The borings will be drilled to a maximum depth of 20 feet below existing surface grade. Soil samples will be collected at approximately the following depth intervals from those borings:

- 0 to 2 inches
- 2.0 to 2.5 feet
- 4.5 to 5.0 feet
- 9.5 to 10.0 feet
- 14.5 to 15.0 feet
- 19.5 to 20.0 feet.

Therefore, during BASIN & RANGE's efforts to sample the water bore-out pits, 24 soil samples will be collected at depths ranging from 0 to 20 feet below existing surface grade in the water bore-out pits.

Three near-surface soil samples (i.e., 0 to 2 inches below existing surface grade) and three shallow soil samples (i.e., 6 to 12 inches below existing surface grade), spaced approximately 15 feet apart, will be collected from each of the five berms (*Exhibit 2-1*). The three samples collected from a depth of 0 to 2 inches in each berm will be composited into one sample and the three samples collected from a depth of 6 to 12 inches in each berm will be composited into a second sample, resulting in two composite samples for each of the five berms. It is believed that this approach will provide a sufficient number of analyses from which to provide an accurate and precise estimate of average chemical characteristics of the soil. Therefore, during the proposed sampling investigation, 30 samples will be collected and composited into ten samples from the berms surrounding the water bore-out pits.

BASIN & RANGE also will perform soil sampling beneath joints in the trough leading from the water bore-out operations building to the pits. Samples will be collected at three locations beneath the trough to assess possible contaminant migration (if any) through the joints into underlying soils. In addition, soil samples will be collected from four locations in the area immediately surrounding the pits to assess if water bore-out operations have impacted those soils. As described above, authoritative sampling techniques also will be employed in those areas. Sample locations along the concrete trough were selected near the top, middle, and bottom of the trough, beneath the joints. The distance between those sample locations is approximately 100 feet, as shown on *Exhibit 2-1*. Four soil sample locations have also been selected in surrounding soils immediately adjacent to the sides of the pits (*Exhibit 2-1*). Soil samples will be collected from those locations at depths of 0 to 2 inches and 6 to 12 inches below existing surface grade. Therefore, a total of six samples will be collected beneath joints in the concrete trough and eight samples will be collected in surrounding soils during the proposed investigation.

2.2 ANALYSIS OF SOIL SAMPLES

Soil samples collected during this investigation will be analyzed for leachable and total concentrations of cadmium, chromium, and lead using the TCLP and the acid digestion sample preparation method, respectively. As required in paragraph 14 of the Consent Judgment, results of the TCLP tests will be used to evaluate for the presence and lateral and vertical extent of contamination (if any) from hazardous waste or hazardous waste constituents at the water bore-out pits. Total metals concentrations will be compared with the concentrations of naturally occurring metals in background samples collected at the site. In addition, the samples will be analyzed for the total concentration of ammonium perchlorate using a specific ion detection method for purposes of compliance with other requirements of the Consent Judgment or applicable law. The analytical methods were selected based on the composition of typical ammonium perchlorate and ammonium nitrate propellants disintegrated during water bore-out operations and the results of previous soil sampling conducted at the site.

Toxicity characteristic leaching procedure extractions will be performed in accordance with the procedures set forth under EPA Sample Preparation Method 1311 as specified in 40 CFR § 261 Appendix II. The acid digestion of soils will be performed following procedures set forth under EPA Method 3050. Specific metals analyses will be performed using their respective analytical procedures as described in SW-846 (*EPA, 1986*). Those parameters and methods are summarized in *Table 2-2*. Because EPA has not published a specific analytical procedure for ammonium perchlorate, the analytical procedure for that compound will be developed by the analytical laboratory, in consultation with Talley, in accordance with generally accepted chemical analysis principles and procedures. Laboratory analyses will be performed by Turner/CAS Laboratories (Turner) in Tucson, Arizona.

A summary of analytical parameters and methods for samples collected during this sampling program is provided in *Table 2-2*. Initially, a total of 16 near-surface (i.e., from about 0 to 2 inches below existing surface grade) soil samples and eight samples obtained at depths of 2.5 and 5 feet below grade will be analyzed. Additionally, three background samples, three duplicates, and six blank samples will be analyzed during this sampling program. Based on the analytical results for the near-surface soil samples collected from the berms, soil surrounding the pits, and beneath the trough joints, soil samples collected at depths of 6 to 12 inches below existing surface grade may be analyzed to evaluate the vertical extent of the analytes (if any) detected in those areas. Additionally, based on the analytical results for the soil samples collected at depths of 0, 2.5, and 5 feet below grade in the water bore-out pits, additional samples collected from depths of 10, 15, and 20 feet may be analyzed to evaluate the vertical extent of the analytes (if any) detected in the shallower samples. If it is necessary to analyze samples collected from 6 to 12 inches, or 10, 15, or 20 feet below existing surface grade, the background samples collected from the respective depths, as well as additional duplicate samples would be analyzed.

2.3 FIELD METHODS AND PROCEDURES

In general, field and sampling procedures specify requirements for field activities including drilling and sampling equipment, methods for collecting samples, sample identification, shipping, and documentation. The following sections describe the

TABLE 2-2. ANALYTICAL PARAMETERS AND METHODS FOR THE SAMPLING PROGRAM AT TALLEY'S WATER BORE-OUT PITS

Analytical Parameter	EPA Analytical Method[2]
TCLP[1] Extraction Method	1311
Acid Digestion of Sediments, Sludges, and Soils	3050
Cadmium	7130
Chromium (total)	7190
Lead	7420
Ammonium Perchlorate	NE[3]

NOTES: (1) TCLP= Toxic Characteristic Leaching Procedure per EPA Method 1311 as specified in 40 CFR 261, Appendix II

(2) Method numbers are derived from U.S. Environmental Protection Agency (EPA)

(3) Environmental Protection Agency has not established a specific analytical procedure for ammonium perchlorate. Therefore, the analytical procedure to be used for that compound will be developed by the analytical laboratory, in consultation with Talley, in accordance with generally accepted chemical analysis principles and procedures.

site-specific field methods and procedures that are proposed for this investigation including the following items:

- Specific field sampling procedures
- Containers used for sample collection
- Sample preservation methods and holding times
- Sample shipping procedures
- Chain-of-custody procedures
- Forms, notebooks, and procedures to be used to record sample history, sampling conditions, and analyses to be performed.

Prior to initiating any sampling activities, a clearance survey of the site will be conducted to ensure that no subgrade structures or utilities are present at the water bore-out pits. Upon completion of the clearance survey, BASIN & RANGE will begin the sampling program.

2.3.1 Sample Collection Procedures

Samples will be collected from the water bore-out pits in accordance with the procedures outlined below.

2.3.1.1 Near-surface Soil Sampling Procedures. Stainless-steel trowels are deemed to be the best tools for collecting representative samples of near-surface soils at the water bore-out pits. Thus, BASIN & RANGE will use the following procedures to collect near-surface soil samples:

1. Using a decontaminated trowel, collect the sample and transfer it into an appropriate sample container.
2. Verify that a Teflon™ liner exists in the lid of the sample container, if required. Secure the lid tightly. Label the sample container with the appropriate sample tag. Label the tag completely, addressing appropriate methods and parameters.
3. Place the sample container in a self-sealing plastic bag and store in a portable cooler (containing blue ice) for transport to the laboratory.

Maintain sample temperature at about 4°C. Complete chain-of-custody documents and record pertinent information in the field log book.

4. Decontaminate equipment between all sample locations and sampling intervals using procedures described in Section 2.3.3 of this plan to minimize the potential for cross-contamination.

2.3.1.2 Hand Auger Procedures. The hand auger method will consist of a core barrel, an auger bit, a series of rods, and an "*T*" handle. The hand auger is comprised of stainless steel and, in general, has a core barrel that is about 3 inches in diameter and from 6 to 8 inches in length. This sampling method will be used to obtain samples from the berms and soil surrounding the pits, as well as beneath the joints in the concrete trough. BASIN & RANGE will use the following procedures to collect soil samples using the hand auger:

1. Advance the decontaminated hand auger into the soil by twisting the "*T*" handle. Depending on the length of the core barrel, the auger will be advanced in 6-inch intervals. If auger refusal is encountered before the desired sampling depth is achieved, the hand auger would be withdrawn, decontaminated, and re-inserted at a new location just a short distance from the original sampling point.

2. When the core barrel is full, withdraw the auger and remove the soil from the barrel using a decontaminated, stainless steel extruder.

3. When the desired sampling depth is achieved, remove the auger from the borehole, extrude the soil from the core barrel, and decontaminate the equipment. Following decontamination, carefully place the auger back in the borehole and collect the sample by advancing the core barrel.

4. After collecting the sample, withdraw the auger and extrude the soil into an appropriate sample container using the decontaminated, stainless steel extruder.

5. Verify that a Teflon™ liner is present in the lid of the sample container, if required. Secure the lid tightly. Label the sample container with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories and parameters.

6. Place the sample container in a self-sealing plastic bag and store it in a portable cooler (containing blue ice) for transport to the laboratory. Maintain sample temperature at 4°C. Complete chain-of-custody documents and record pertinent information in the field log book.

7. Decontaminate the equipment between all sample locations and sampling intervals to minimize the potential for cross-contamination.

2.3.1.3 Drilling Sampling Procedures. During drilling of the borings located in the water bore-out pits, soil samples will be acquired at approximately 2.5-foot intervals from 0 to 5 feet below existing surface grade, and at 5-foot intervals thereafter, to a maximum depth of 20 feet, using the following procedures:

1. Advance the borehole to the desired depth, remove excess cuttings, and detach drill rods.

2. Attach 12-inch long by 2.5-inch diameter core barrel sampler to the drill rods and lower into the borehole. The sampler should contain two 6-inch long by 2-inch diameter brass liners.. Do not allow the sampler to drop onto the soil being sampled.

3. Position hammer above and attach the anvil to the top of the drill rods.

4. Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the borehole, withdraw the sampler and drill rods from the borehole and remove the cuttings.

5. Mark drill rods in two successive 6-inch increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-inch increment.

6. Drive the sampler with blows from a calibrated rated 140(± 1)-pound hammer and count the number of blows applied in each 6-inch increment until no advancement is observed.

7. Record the number of blows required to achieve each 6-inch increment of penetration. The first 6 inches is considered to be a seating drive. If the sampler is driven less than 12 inches, the number of blows for each complete 6-inch increment and for each partial increment should be recorded on the boring log. For partial increments, report the depth of penetration to the nearest inch, in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods and hammer, note this information on the boring log.

8. The raising and dropping of the 140-pound hammer can be accomplished using either of the following two methods:

   a. A trip, automatic, or semiautomatic hammer drop system that drops the hammer 30 inches.

b. A cathead to pull a rope attached to the hammer. The cathead should be essentially free of rust, oil, or grease. For each hammer blow, employ a 30-inch lift and drop. The operation of pulling and throwing the rope should be performed rhythmically without holding the rope at the top of the stroke.

9. After driving the sampler to the desired depth, withdraw the sampler and drill rod from the borehole and open the sampler. Record the percent recovery or the length of sample recovered and describe the soil samples including composition, color, stratification, and condition following the Unified Soil Classification System.

10. Collect the leading brass liner for laboratory analysis. Seal and cover both ends of the liner using Teflon™ paper and plastic end caps. Label the liner with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters.

11. Place the liner in a self-sealing plastic bag and store it in a portable cooler containing blue ice for transport to the laboratory. Complete chain-of-custody documents and record pertinent information in the field log book.

12. Use the sample in the remaining liner for lithologic descriptions.

13. Decontaminate sampling equipment between sample locations and sampling intervals to minimize the potential for cross-contamination.

2.3.2 Disposal of Contaminated Materials

Cuttings from the drilling operation and decontamination rinsate that may be produced during the sampling program will be contained on site in separate 35- or 55-gallon drums. Following final decontamination of sampling equipment and materials, a composite sample of the rinsate will be collected for laboratory analysis. The rinsate will be analyzed for the same analytes selected for the soil samples. Residues will be sealed in the appropriate drums and each drum will be labeled using indelible ink showing the site name, type of residue, and date. If chemical analyses indicate that the cuttings and/or rinsates are hazardous waste, they will be disposed of in accordance with applicable state and federal regulations. Talley will be responsible for disposing of all contaminated materials. The facility selected by Talley for disposal of the contaminated materials is dependent on the sample analytical results and acceptance of the waste by the disposal facility. It is anticipated that residuals generated during the sampling program that meet the

definition of a hazardous waste will be transported by Chemical Disposal Company to Environmental Services of Idaho, Inc.'s permitted disposal facility in Grandview, Idaho.

2.3.3 Sampling and Drilling Equipment Decontamination Procedures

Tools and materials used during sampling will be thoroughly cleaned prior to each sampling event to minimize the potential for cross-contamination and maintain sample integrity prior to laboratory analysis. Equipment cleaning procedures to be used during this investigation are summarized in *Table 2-3*. Sampling equipment will be washed over a bucket containing Liquinox detergent and water, then rinsed with tap water. Finally, deionized water will be "spray-rinsed" over the equipment and collected in a bucket. Decontaminated equipment will be dried using lint-free towels or cloths or allowed to air dry. As discussed in Section 2.3.2, provisions will be made for containing the rinsates that are produced during the equipment decontamination process. Detergent and rinse waters will be changed at least once each sampling day, or more frequently as deemed necessary by BASIN & RANGE.

2.3.4 Sample Containers and Preservation

The drilling contractor will provide precleaned, 6-inch long, 2-inch diameter brass liners for soil samples collected using a hollow-stem auger drill rig. The analytical laboratory will provide pre-cleaned, 8-ounce glass sample containers having Teflon™-lined plastic covers for samples collected using a scoop or hand auger.

Sample containers will be packed in coolers containing blue ice to help maintain the temperature of the samples at 4°C. Additional sample containers and preservation methods, if necessary, would be selected in accordance with the guidelines provided in SW-846 (*EPA, 1986*). Sample container and preservation requirements and maximum sample holding times for TCLP and total metals are summarized in *Table 2-4*. Specific requirements for ammonium perchlorate analytes have not been established by EPA; therefore, sample container and preservation requirements, as well as maximum sample holding times for those analytes, will be established by the

TABLE 2-3. SUMMARY OF EQUIPMENT CLEANING PROCEDURES

Equipment/Material Description	Cleaning Procedure	Drying Procedure
Drill rig	A	D
Downhole drill tools (augers, drill rod)	A	D
Sampler assembly	B	D or E, F
Sample liners and end caps	B	D or E, F
Sampling equipment (trowel, hand auger, etc.)	B	D or E, F
Sample containers	C	C
Portable coolers	G	D

Cleaning and Drying Procedures:

A - Steam-cleaned with tap water
B - Liquinox detergent wash, tap water rinse using deionized water
C - Cleaned and prepared following laboratory quality control procedures
D - Air dried on plastic sheets
E - Dried with lint-free, cloth towels
F - Cleaned and wrapped with plastic until ready for use
G - Wiped clean with detergent solution

TABLE 2-4. SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Parameter	Container[1]	Preservation Temperature	Maximum Holding Time
TCLP Metals	glass/brass liner	4°Centigrade	6 months until TCLP[2] extraction; 6 months until analysis
Total Metals	glass/brass liner	4°Centigrade	6 months until acid digestion; 6 months until analysis
Ammonium Perchlorate	glass/brass liner	4°Centigrade	NE[3]

NOTES:
(1) Eight-ounce, wide-mouth, glass container having Teflon™-lined lid will be used when soil samples are collected using a scoop or hand auger. Samples obtained using a hollow-stem auger drill rig will be contained in 6-inch long, 2-inch diameter brass liners.
(2) Toxic Characteristic Leaching Procedure.
(3) Environmental Protection Agency has not established specific sample container and preservation requirements or a maximum holding time for ammonium perchlorate analyses. Therefore, those requirements will be established by the analytical laboratory, in consultation with Talley, in accordance with generally accepted chemical analysis principles and procedures.

analytical laboratory, in consultation with Talley, in accordance with generally accepted chemical analysis principles and procedures.

2.3.5 Sample Packaging and Shipping

Individual sample containers will be protected with a layer of plastic "bubble wrap," placed within self-sealing plastic bags, and stored in portable coolers containing blue ice. Empty space within each cooler would be filled with inert materials for the purpose of cushioning the samples and preventing possible breakage during shipment. Sample containers will be handled using standard chain-of-custody procedures (Section 2.3.6.5) and, if necessary, will be stored overnight in a secure, indoor area. Sample containers will be sealed using chain-of-custody tape to detect possible tampering or possible unauthorized entry.

Samples will be transported to the laboratory within approximately 24 hours of collection by Engineers Expediting Service Inc. of Phoenix. Shipping containers will meet applicable state and federal Department of Transportation requirements for safe transport. Additionally, all containers will be sealed in a manner such that possible tampering or unauthorized entry can be detected immediately upon receipt by the testing laboratory. The chain-of-custody forms will be sealed in clear plastic envelopes and affixed to the outside of the shipping containers.

2.3.6 Sample Documentation

In addition to sample labels and field log books, the following "standard" forms will be maintained during field sampling operations:

- Sample Record
- Chain-of-Custody
- Sample Analysis Request
- Photographic Log
- Lithologic Borehole Log.

2.3.6.1 Sample Labels. Samples will be labeled at the time of collection, and the following information will be included on each label:

- Project number
- Sample location and depth
- Sample ID number
- Preservative (if applicable)
- Date and time of collection
- Initials of collector.

To discourage tampering or unauthorized opening of samples, chain-of-custody seals will be placed over each container lid and will include the following information:

- Project number
- Sample ID number
- Initials of sample collector.

2.3.6.2 Sample Numbers. Near-surface sample numbers will begin with a project identifier (Talley = T) and will be assigned sequentially increasing numbers. Sample numbers will indicate the area being sampled (i.e., earthen berms = EB; surrounding area = SA; trough joints = TJ), sample number, and alphanumeric digit (A or B) to indicate the sample depth (A = 0 to 2 inches; B = 6 to 12 inches). Therefore, a sample identified as "T-TJ-1A" would indicate that the sample was the first sample collected beneath the trough joints at a depth of 0 to 2 inches. Sample numbers for soil samples collected from the soil borings will have the project identifier (T), followed by the initials BP for water bore-out pits and BG for background, followed by the boring designation (i.e., A, B, C, D, or E) and the approximate sample depth (i.e., 0, 0.5, 2.5, 5, 10, 15, or 20). Blank samples will be identified using the same identification scheme (i.e., project identifier [T] and location [BP]), but will be followed with a "TB," "EB," or "FB" to indicate that the sample is a trip, equipment, or field blank, respectively. Duplicates will be numbered in such a manner to prevent laboratory personnel from knowing the true identity of the sample.

2.3.6.3 Field Log Book. Information pertinent to the sampling program will be recorded in a hard bound field log book. This includes, but is not limited to, the following:

- Project name and number
- Location of site
- Site personnel contact(s)
- Purpose of sampling
- Date and time of collection
- Sampling locations, sample identification numbers, and methodology
- Number and volume of samples taken
- Field observations (i.e., sample descriptions)
- Sample distribution
- Maps, photographs, and/or drawings
- Field measurements
- Signatures of sampling personnel.

The conditions of the site, a sketch map of the site, and the location of the sampling points will be recorded in the field log book. The sampling points will be numbered and shown on scaled drawings.

Because sampling situations are expected to vary widely, specific guidelines cannot be given as to the extent of information which will be entered into each field log book. Sufficient information will be recorded, however, so that future researchers can reconstruct the sampling program without having to consult directly with the field sampling personnel. Field log books will be maintained in a secure place.

2.3.6.4 Sample Record Form. Pertinent information regarding soil samples are recorded on the Sample Record Form, depicted in *Exhibit 2-2*. The following information is routinely entered on the form:

a. Project name
b. Project number
c. Sample identification

BASIN & RANGE HYDROGEOLOGISTS, INC.
FIELD SAMPLING RECORD

Project Name _____
Project Number _____
Date _____

SAMPLE RECORD

Sample ID No. _____
Sample Medium _____
Sample Location _____
Sample Depth (ft) _____
Time of Collection _____
Initials of Collector _____
Sampling Method _____

Field Observations, Sample Description, and Unified Soil Classification System Designation _____

Photograph Number _____

SAMPLE RECORD

Sample ID No. _____
Sample Medium _____
Sample Location _____
Sample Depth (ft) _____
Time of Collection _____
Initials of Collector _____
Sampling Method _____

Field Observations, Sample Description, and Unified Soil Classification System Designation _____

Photograph Number _____

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	FIELD SAMPLING RECORD	EXHIBIT 2-2
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d. Sample medium
e. Sample depth
f. Time of sample collection
g. Initials of sample collector(s)
h. General sample location
i. Description of sampling method
j. Field observations
k. Photograph number
l. Sample description (Unified Soil Classification System [USCS] designation, if applicable)
   - USCS soil type with one descriptive adjective
   - grain size: (e.g., fine, medium, coarse)
   - grain shape: (e.g., angular, subangular, subrounded, rounded)
   - grading of predominant fraction: (e.g., poor or well)
   - amount of predominant fraction: (e.g., "some": >20%, "little": 13-20%, "trace": 5-12%).

2.3.6.5 Chain-of-custody Record and Sample Analysis Request Form. After each sample has been collected, the appropriate chain-of-custody record, which will also serve as the sample analysis request form, will be completed (*Exhibit 2-3*). The chain-of-custody record will accompany the samples at all times. The chain-of-custody for possession and responsibility of a sample will be documented from the time and place of sample acquisition to the time and place of its final destination. BASIN & RANGE will be responsible for the care and custody of the samples until they have been transferred to Engineers Expediting Service Inc. for delivery to Turner/CAS Laboratories.

The information recorded on the chain-of-custody record will include the sample identification number, date, time, matrix, number of containers, sampler's signature, project number, project name, and analysis requested. Each person or organization who relinquishes and/or receives the samples will sign and date the form in the appropriate space. Original records will remain with the samples until relinquished to the laboratory.

TURNER/CAS LABORATORIES INC.
1881 W. PRINCE ROAD
TUCSON, ARIZONA 85705
602 293-3406 ■ FAX# 602 888-7519

Chain of Custody

DATE _____ PAGE _____ OF _____

COMPANY _____
ADDRESS _____
PROJ. MGR. _____
SAMPLERS (SIGNATURE) (PHONE NO.)

SAMPLE ID.	DATE	TIME	MATRIX	LAB ID.	HALOGENATED VOLATILES 601/8010	AROMATIC VOLATILES 602/8020	PHENOLS 604/8040	PHTHLATE ESTERS 606/8060	PESTICIDES/PCB 608/8080	PETROLEUM HYDROCARBONS 418.1	OIL & GREASE	PHENOLS 420.1	PRIORITY POLLUTANT METALS (13)	TCLP METALS (8)	HAZARDOUS WASTE PROFILE	SWDA-INORGANICS PRIMARY/SECONDARY	TOTAL COLIFORM FECAL COLIFORM							NUMBER OF CONTAINERS

ANALYSIS REQUEST

PROJECT INFORMATION	
PROJECT	
PO NO	
SHIPPING ID NO	
VIA:	

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	
CHAIN OF CUSTODY SEALS	
REC'D GOOD CONDITION/COLD	
CONFORMS TO RECORD	
LAB NO.	

INVOICE TO:
_____
_____
_____

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY		RELINQUISHED BY	
(Signature)	(Time)	(Signature)	(Time)
(Printed Name)	(Date)	(Printed Name)	(Date)
(Company)		(Company)	
RECEIVED BY		RECEIVED BY (LABORATORY)	
(Signature)	(Time)	(Signature)	(Time)
(Printed Name)	(Date)	(Printed Name)	
(Company)		TURNER/CAS LABORATORIES, INC.	

DISTRIBUTION: WHITE, CANARY - TURNER/CAS LABORATORIES • PINK - ORIGINATOR

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	CHAIN-OF-CUSTODY RECORD AND SAMPLE ANALYSIS REQUEST FORM	EXHIBIT 2 - 3
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Laboratory personnel receiving the samples will enter the following information on the form:

- Name of person receiving the samples
- Laboratory sample numbers
- Condition of the samples received
- Date and time of sample receipt.

2.3.6.6 Photograph Log. The following information will be recorded on the photograph log, which is shown in *Exhibit 2-4*: project name and number, frame number, date, location, and description of the photograph.

2.3.6.7 Lithologic Borehole Log. Soil samples and descriptions acquired during drilling are recorded on a standard lithologic borehole log (*Exhibit 2-5*). The following information is routinely entered on the log or attached to it:

- Project name
- Project number
- Borehole number
- Page numbers
- Name of person recording and initials
- General borehole location
- Description of drilling equipment used, including drilling agency, driller's name, rig manufacturer and size, tool size, and method of drilling
- Brief description of well construction, backfill and seal materials (when appropriate)
- Special problems encountered and their resolution, such as squeezing hole or recurring problems at a particular depth
- Distinct boundaries between soil types and/or lithologies and depth of occurrence
- Depth of first encountered ground water (when appropriate)

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PHOTOGRAPH LOG

Project No: Project Name:			Page ____ of ____
FRAME NUMBER	DATE	LOCATION	DESCRIPTION
By: Date:			

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	PHOTOGRAPH LOG	EXHIBIT 2 - 4
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BOREHOLE LOG

Project Name:								
Project Number:	Borehole Number:							Sheet ___ of ___
Depth (feet)	Description	Lithology	OVA (ppm)	Samples				Remarks
				Number	Type	Blow Count	Drilling Rate/Time	

BASIN & RANGE HYDROGEOLOGISTS

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	LITHOLOGIC BOREHOLE LOG	EXHIBIT 2 - 5
FILE NO.: 91-108-001	BASIN & RANGE	DATE: DECEMBER 4, 1991

- Headspace readings of VOCs using an HNu or OVA field instrument, if appropriate
- Estimated depth interval for each sample taken or classified, length of sampled interval, length of sample recovery, and sampler type and size
- Each soil sample collected will be described on the log; soil classifications will be in accordance with the Unified Soil Classification System (USCS; ASTM D2488-69)
- Soil classifications will be prepared in the field at the time of sampling but may be changed based on results of laboratory tests and/or review. Changes will be documented in appropriate project files
- Soil sample descriptions will be recorded on the log in the following order:

  - USCS soil type with one descriptive adjective
  - grain size: fine, medium, coarse
  - grain shape: angular, subangular, subround, round
  - grading or predominant fraction: poor or well (rate)
  - amount of predominant fraction: some >20%; little 13-20%, trace 5-12%
  - relative amount gravel, cobbles, or boulders: occasional, few, many/numerous
  - color
  - odor
  - natural density.

2.3.7 Quality Control Samples

Quality control (QC) samples are required to document the accuracy and precision of the sampling. The QC samples proposed for this sampling investigation include background and duplicate samples, travel, field and equipment blank samples.

2.3.7.1 Background Samples. Background samples will be collected from a location approximately 100 feet southwest of the water bore-out pits on the outside of the temporary fence, as shown in *Exhibit 2-1*. Those samples will be collected in an area that appears to be undisturbed by water bore-out pit operations (e.g., native desert area). Samples will be collected at depths of approximately 0, 0.5, 2.5, 5, 10, 15, and 20 feet below existing surface grade. Initially, the following three samples will be analyzed for selected TCLP metals, total metals, and ammonium perchlorate: 0, 2.5, and 5 feet below existing surface grade. If necessary, based on the analytical results

for the soil samples collected from the water bore-out pit area, the remaining background samples also would be analyzed for those compounds.

2.3.7.2 Duplicate Samples. Personnel will collect "blind" field duplicate samples at the rate of approximately 10% of the total samples per day if more than 10 samples are collected, or at the rate of one sample per sampling activity if less than 10 samples are collected in a given day. Duplicate samples will be collected from areas suspected of being the most highly contaminated. Care will be taken by BASIN & RANGE to ensure that as "true" a duplicate as possible is obtained. Each duplicate sample will be collected, numbered, packaged, and sealed in the same manner as other samples so that it cannot be identified as a duplicate by laboratory personnel. A minimum of 5 duplicate samples will be required during this sampling program because a total of 48 soil samples (excluding QC samples) will be collected from the water bore-out pit area for possible laboratory analysis.

2.3.7.3 Travel Blanks. A travel blank sample, consisting of analyte-free water, will be supplied by the analytical laboratory and will accompany each shipment of sample coolers from the laboratory to the field and back to the laboratory. Travel blanks will be analyzed for the same analytes selected for the soil samples. BASIN & RANGE anticipates that at least two sample shipments will be made during this investigation; therefore, at least two travel blanks will be analyzed.

2.3.7.4 Equipment Blanks. One equipment blank per day will be collected to ensure that sampling equipment has been cleaned effectively. After decontamination, equipment blanks will be obtained by pouring deionized water over the surfaces of the sampling tools (i.e., hand auger barrels or trowels) and collecting the water in appropriate sample containers. The equipment blanks will be shipped to the laboratory and analyzed for the parameters listed in *Table 2-2*. It is anticipated that two days will be required to complete the soil sampling outlined in this plan. Therefore, two equipment blanks will be collected and analyzed during the project.

2.3.7.5 Field Blanks. Field blanks, consisting of analyte-free water poured directly into an appropriate sample container during sampling activities, will be collected at the rate of one field blank per sampling day. The field blanks will be

analyzed for the same analytes selected for the soil samples to evaluate possible cross-contamination of the samples by airborne contaminants. It is anticipated that two days will be required to complete the soil sampling outlined in this plan. Therefore, two field blanks will be collected for analysis during this investigation.

2.3.7.6 Laboratory QA/QC Samples. Laboratories routinely perform matrix spike and lab duplicate analyses on field samples as a quality control check. As recommended by EPA Region 9, at least one field sample per week or one per 20 samples (including field blanks and duplicates), whichever is greater, will be designated as the "lab QC sample" for the matrix spike and lab duplicate analyses.

2.3.8 Backfilling of Boreholes

Soil removed from hand augered boreholes (i.e., maximum depth of 12 inches) will be temporarily placed on plastic sheeting and used to backfill the boreholes following sample collection. At locations where drilling is performed, BASIN & RANGE will backfill the boreholes using Portland-type cement.

2.4 QUALIFICATIONS OF SAMPLING AND ANALYTICAL PERSONNEL

BASIN & RANGE has assembled an experienced team of professional earth scientists to implement the SAP. Following are the names and project responsibilities of the project team:

Mr. David L. Kirchner	-	Project Director
Mr. Philip J. Lagas	-	Project Manager
Mr. Mark A. Shellhorn	-	Project QA/QC Coordinator
Ms. Kathleen D. Kirchner	-	Health and Safety Officer and Field Supervisor
Mr. C. Lee Morris	-	Field Staff.

Field personnel have received health and safety training in accordance with Occupational Safety and Health Administration (OSHA) 1910.120. Resumes of BASIN & RANGE project personnel are included in *Appendix D-1*. Additionally, resumes of

other BASIN & RANGE personnel are provided in the event that their assistance is needed.

Laboratory personnel who will be responsible for sample handling and analytical testing during this program are as follows:

Ms. Nancy D. Turner
Ms. Marianne J. Hester
Mr. Thomas M. Graf.

Resumes of Turner/CAS Laboratories' personnel are presented in *Appendix D-2.*

2.5 NOTIFICATION OF ADEQ

Arizona Department of Environmental Quality will be notified at least two working days prior to commencing field activities at the water bore-out pits. Written and verbal notification will be provided.

3.0 SITE SAFETY PLAN

3.1 PURPOSE

This Site Safety Plan has been prepared for personnel engaged in sampling activities at the Talley water bore-out pits in Mesa, Arizona. The purpose of the Site Safety Plan is to:

- Establish personnel safety/protection standards that meet or exceed regulatory requirements for hazardous waste site workers
- Define responsibilities of different organizations and personnel
- Establish safe operating procedures relative to physical and chemical conditions encountered on the site
- Delineate contaminated work areas
- Provide contingencies for unforeseen circumstances which may arise during the course of proposed sampling activities.

This plan outlines health and safety procedures and describes protective equipment required at the site to minimize the potential for chemical exposure of field sampling personnel. The procedures and equipment requirements presented herein were developed based on a review of available data and an evaluation of the potential field hazards associated with exposure to specific contaminants during sampling activities.

Standard construction safety procedures and requirements are not included in this plan. Individual contractors will be responsible for construction safety.

3.2 HEALTH AND SAFETY RESPONSIBILITIES

A Site Health and Safety Officer (SHSO) will be designated for sampling activities. The responsibilities of the SHSO will be as follows:

- Ensure that all personnel allowed to enter the site are made aware of the potential hazards associated with substances known or suspected to be present at the site

- Ensure that personnel are made aware of the provisions of the Site Safety Plan and are instructed in the safety practices defined in the plan, including emergency procedures
- Ensure that the appropriate safety equipment is available and properly utilized by field personnel.

Additionally, the SHSO may alter the Site Safety Plan to fit on-site conditions and will retain the authority to stop all work in the event that unsafe work practices or conditions are observed (e.g. atmospheric storms).

During performance of the work, all personnel will be asked to "think safety" at all times, both for themselves and their fellow workers, and for the occupants or users of the areas adjacent to the site. Safety hazards which are actually observed, or those which an employee believes are likely to occur, will be brought to the attention of that employee's supervisor and/or the SHSO.

3.3 HAZARD ASSESSMENT

3.3.1 Potential Chemical Exposure

The disintegration of ammonium perchlorate and ammonium nitrate propellants by Talley's water bore-out process could have released a varied mixture of materials composed of complex compositions of chemicals. Among those chemicals are heavy metals which could include cadmium, chromium, and lead. Those metals may be present in a wide range of concentrations in the soils at the water bore-out pits. Hazards presented by these various chemicals to site assessment personnel are discussed below:

Cadmium

Cadmium is a heavy metal whose primary route of exposure is through inhalation and ingestion. Short-term exposure to cadmium dust (as cadmium) can cause irritation of the nose and throat. Overexposure can cause delayed cough, chest pain, sweating, chills, shortness of breath, weakness, and death. Ingestion causes nausea, vomiting, diarrhea, and abdominal cramps. Long-term exposure may cause loss of sense of smell, ulceration of the nose, emphysema, kidney damage, and mild anemia.

It has been reported in the literature that cadmium may increase the incidence of prostate cancer. As with most heavy metals, protection against exposure to cadmium dust consists of respiratory protection and protection of the skin, as appropriate. The American Conference of Governmental Industrial Hygienists (ACGIH) 8-hour Threshold Limit Value (TLV) for cadmium dust is 0.05 milligrams per cubic meter of air (mg/m^3) (*ACGIH, 1989*). Cadmium has been identified by the ACGIH as a suspected human carcinogen. The Occupational Health and Safety Administration (OSHA) Permissible Exposure Limit (PEL) is 0.2 mg/m^3 with an acceptable ceiling value of 0.6 mg/m^3 (*NIOSH, 1990*).

Chromium

Chromium is toxic by ingestion, affecting the gastrointestinal and digestive systems. Upon contact with the skin, chromium and chromium salts have a corrosive affect. Chromates are suspected human carcinogens of the lungs, nasal cavity, and sinuses and are also suspected carcinogens of the stomach and larynx. Hexavalent compounds (chromium VI) are more toxic than trivalent compounds (chromium III). Eczematous dermatitis due to exposure to trivalent chromium compounds has been reported. The ACGIH TLV and OSHA PEL for total chromium are both 0.5 mg/m^3 (*ACGIH, 1989; NIOSH, 1990*). Additionally, ACGIH and OSHA report a TLV and PEL of 0.05 mg/m^3 for hexavalent chromium.

Lead

Lead is a common heavy metal systemic poison. The primary route of exposure of concern during this project is through inhalation, although dermal absorption and ingestion also must be considered. Once introduced into the human body, lead acts on a variety of organ systems. In the hematopoietic (blood) system, lead can produce symptoms of anemia by reducing the life span of red blood cells. Lead in the nervous system tends to decrease peripheral nerve activity and destroy brain cells leading to dysfunction of basal mental functions, convulsions, delirium and cerebral edema. Lead can also act upon the renal system, leading to renal failure. Protection against lead consists of respiratory protection, although workers are encouraged to avoid handling lead-contaminated materials without use of appropriate skin protection (gloves, etc.). The ACGIH TLV for lead is 0.15 mg/m^3 (*ACGIH, 1989*) and the OSHA PEL for lead is 0.05 mg/m^3 (*NIOSH, 1990*).

3.3.2 Potential Physical Hazards

On any job site there is a potential for workers to slip, trip or fall. This is especially true because the use of personal protective equipment may limit mobility and dexterity. All personnel will be warned of this potential for injury and will be asked to exercise care when moving around the site.

3.3.3 Heat Stress

The heat stress load on sampling personnel will be assessed by supervisors and the SHSO. Heat stress monitoring will not be performed if temperatures do not present immediate health hazards. Protective clothing in warm environments can create heat stress. Some of the following control measures may be used to help control heat stress:

- Provision of adequate liquids to replace lost body fluids
- Availability of electrolyte replacement fluids for use by field personnel
- Establishment of a work regime to provide adequate rest periods for cooling down
- Cool area designated as the rest area.

Some symptoms of heat exhaustion are clammy skin, light-headedness, slurred speech, rapid pulse, fatigue, confusion, fainting, and nausea. The following steps will be taken if a person shows signs of heat exhaustion:

1. The victim will be taken to a cool, uncontaminated area
2. Protective clothing will be removed
3. The victim, if conscious, will be given water to drink
4. The victim will be allowed to rest.

Symptoms of heat stroke are similar to heat exhaustion and include hot skin (temperature rise), incoherence, mental confusion, convulsions and unconsciousness. If a person shows signs of heat stroke, the following procedures will be followed:

1. The victim will be taken to a cool, uncontaminated area
2. Protective clothing will be removed
3. The victim, if conscious, will be given water to drink
4. The victim will be allowed to rest.
5. The victim will be cooled with water, cold compresses, and/or fanning
6. The victim will be transported to a medical facility.

3.3.4 "Blue Stake" Drilling Locations

Prior to initiating drilling activities at the water bore-out pits, a professional utility locator service (Blue Stake) will be retained for the purpose of identifying the approximate surface location of buried public utilities in areas where subsurface testing will be performed. A private locator service also will be subcontracted to locate buried utilities on Talley's property in areas where subsurface testing is proposed.

3.4 SAFETY PROCEDURES

3.4.1 General Safety Practices

The following general safety practices will be observed during implementation of the SAP:

1. Prior to mobilizing to the site, field personnel will be briefed on the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communication methods.

2. Field crew members will be made familiar with the physical site characteristics, including:

   - Wind direction in relation to the area to be sampled
   - Accessibility to associates, equipment, vehicles
   - Communication
   - Hot zone (areas of known or suspected contamination)
   - Site access
   - Nearest water sources.

3. Eating and chewing gum or tobacco will be prohibited in contaminated or potentially contaminated areas or where the possibility for transfer of contamination exists. No cigarette smoking will be allowed at the site.

4. Field personnel will be required to thoroughly wash their hands before eating or leaving the work area.

5. To the extent possible, field personnel will be asked to avoid contact with potentially contaminated surfaces. The field crew also will avoid, whenever possible, kneeling on the ground and leaning or sitting on drums, equipment, or ground. Monitoring equipment will not be placed on potentially contaminated surfaces (i.e., drums, ground, etc.).

6. No facial hair which interferes with a satisfactory qualitative respirator fit test will be allowed for field crew personnel requiring respiratory protection.

7. Personnel will be made familiar with and knowledgeable about standard operating safety procedures for both equipment utilization and site considerations.

8. Personnel will be made familiar with all aspects of the Site Safety Plan.

9. Consideration will be made for fatigue, heat stress, and other environmental factors influencing the health of personnel.

10. Designated and approved respiratory protective devices and protective clothing will be worn as instructed by the SHSO.

11. Sampling equipment will be washed with detergent and water and rinsed well. Equipment decontamination will be performed on the site.

Field personnel who are expected to work near hazardous materials will receive training in general safety practices, procedures, and equipment use. This training will include thorough familiarization with this document and other such safety directives as may be considered appropriate by the SHSO. The proper care, maintenance, and use of general safety equipment and personal protective equipment (PPE) will be required.

3.4.2 Personal Protective Equipment

Modified Level D personal protective equipment (Modified Level D) will be the primary level of protection worn during the sampling program at the water bore-out pits provided that high levels of contamination and/or airborne health hazards are

not present. Modified Level D will allow for protection from skin contact with contamination, as well as limited respiratory protection with usage of a disposable dust mask. Use of this equipment will greatly aid in decontamination procedures. Personal protective equipment required for Modified Level D includes:

- Tyvek® or cloth coveralls
- Chemical resistant gloves
- Chemical resistant steel toed/shanked safety boots
- Hardhat
- Respiratory protection (half-face molded dust mask)
- Safety glasses/face shield.

Modified Level D will be utilized by all personnel entering the work area.

The SHSO also may require the use of Level C personal protective equipment (Level C) to protect against situations not anticipated in this Plan. Level C is defined by the use of an air purifying respirator and consists of the following:

- Full-face or half-face air purifying respirator with Organic Vapor/Particulate (HEPA) cartridges
- Tyvek® or cloth coveralls
- Chemical resistant outer gloves taped to coveralls
- Chemical resistant inner gloves
- Chemical resistant, steel toed/shanked safety boots taped to coveralls
- Hardhat.

The need for upgrading from Modified Level D to Level C will be determined by on-site physical circumstances (e.g. dusty conditions, odors) requiring the need for additional personal protective controls. This decision will be rendered by the SHSO upon his professional determination that upgrade conditions exist.

3.4.3 Air Monitoring Guidelines

As discussed in Section 3.3, sampling personnel may be exposed to the following metals during implementation of this SAP: cadmium, chromium, and lead. In general, hazards associated with exposure to those metals are related to long-term inhalation or ingestion of metal-bearing dust. Additionally, techniques for on-site monitoring of metal concentrations in air are not readily available. Therefore, air monitoring will not be performed during sampling activities at the water bore-out pits. However, as discussed Section 3.4.2, sampling personnel will be required to wear Modified Level D personal protective equipment (i.e., coveralls, gloves, boots, hardhats, dust masks, and safety glasses) to minimize their exposure to potentially hazardous materials during field activities.

3.4.4 Recommended Drill Rig Safety Guidelines

Drill rig maintenance and safety is the responsibility of the drilling operator. The following information is provided as general guidelines for safe practices on the site:

- No food or beverage will be consumed or stored in the operational areas
- Inspect the route of travel before moving drill rig off-road. Note rocks, trees, erosion, and uneven surfaces
- Remove all passengers from the cab before moving drill rig onto rough or sloped terrain
- Engage multiple-drive power trains (when available) on rig vehicle when mobilizing off-road
- Travel directly up or down grade on slopes when feasible. Avoid off-camber or traverse approaches to drill sites
- Approach changes in grade squarely to avoid shifting loads or unexpected weighting
- Use a spotter (person at grade) to provide guidance when vertical and lateral clearance is questionable
- Lower rig mast when traveling off-road or when moving rig from one location to another

- Secure all loads to rig prior to off-road mobilization
- Locate overhead and buried utilities prior to drilling operations
- Treat overhead electrical lines as if they were energized
- Contact appropriate utility agencies to manipulate and deactivate overhead service in areas that interfere with drilling operations. Do not attempt to handle utilities
- Note wind speed and direction to prevent overhead utility lines from contacting rig derrick. Allow at least 20 feet of clearance between rig mast and utility lines
- Contact appropriate utility agencies to survey, mark, and flag locations of buried utility lines
- Use geophysical techniques, or equivalent, to locate buried utility lines
- Stabilize and level each work site prior to drill rig set-up
- Maintain orderly housekeeping on and around drill rig
- Store tools, materials and supplies to allow safe handling by drill crew members. Proper storage and racks or sills will prevent spreading, rolling, or sliding
- Avoid storage or transportation of tools, materials, or supplies within or on the drill rig derrick
- Maintain working surfaces free of obstructions or potentially hazardous materials
- Store gasoline only in containers specifically designed and approved for such use
- Wear eye protection when chipping, chiselling, or breaking material that present risk of flying objects
- Inspect wire rope, hoisting hardware, swivels, hooks, bearings, sheaves, guides, rollers, clutches, and brakes for abrasions, breaks, wear, fatigue, corrosion, jamming, and kinking
- Avoid the suspension of loads when hoist is unattended
- Prevent hoisting loads directly over field personnel
- Restrict hoisting operations during unfavorable environmental conditions such as rain or high winds

- Maintain safe hand distance from hoisting equipment (e.g., wire rope, hooks, pinch points) when slack is reduced
- Begin auger borings slowly while the drive engine is operating at low RPMs
- Establish a communication system between driller, helper, and geologist for responsibilities during drilling operations.

3.5 DESIGNATION OF WORK AREAS AT THE SITE

Access to hazardous and potentially hazardous areas must be controlled to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors, and the public. A hazardous or potentially hazardous area includes any area where field personnel are required to wear respirators.

Site security will be controlled via established procedures for the facility. The boundaries of hazardous and potentially hazardous areas will be identified by cordons, barricades, or emergency traffic cones or posts, depending on site conditions. If such areas are left unattended, signs warning of the danger and forbidding entry will be placed around the perimeter if the areas are accessible to the public.

Should Level C be required, the site would be divided into two areas designated as follows:

- Exclusion Area, where contaminant exposure exists and may require Level C
- Support Area, which is the remaining site area not requiring Level C.

The exclusion area or zone would consist of the area where drilling and sampling activities would be performed. The decontamination station would be located within the exclusion zone but outside the known or suspected areas of contamination. The boundaries of the exclusion zone would be conspicuously marked with pylons and 2-inch wide OSHA compliance tape. Access to the exclusion zone would be allowed for personnel who have read the Site Safety Plan and are wearing the appropriate level of protective equipment. Traffic would be restricted via controlled entrance and exit

upwind of the investigative activities. An example of an exclusion zone setup is illustrated in *Exhibit 3-1*.

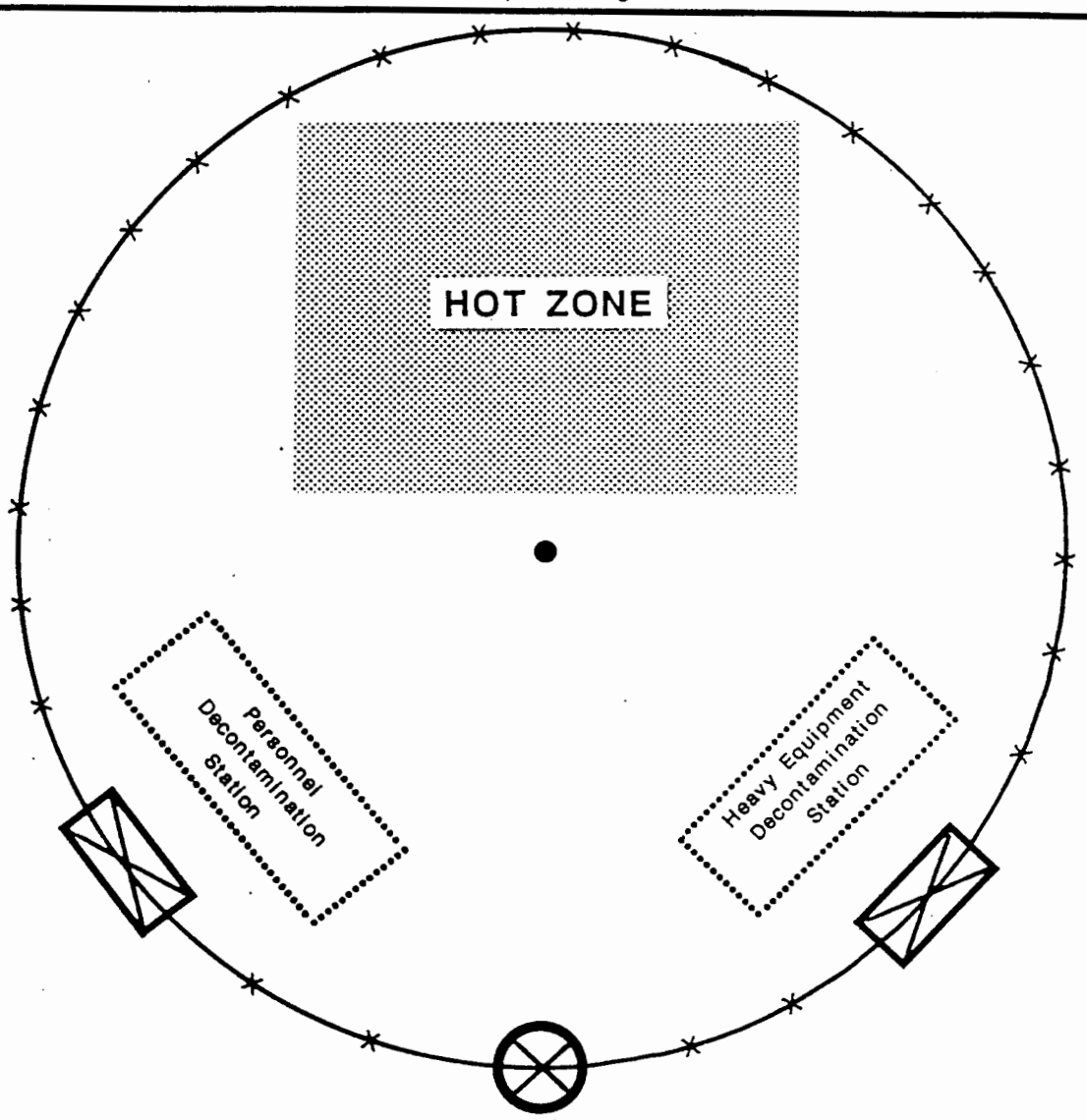
Entry to hazardous areas will be limited to individuals who must work in those areas. Unofficial visitors will not be permitted to enter hazardous areas while work activities in those areas are in progress. Official visitors will be discouraged from entering hazardous areas, but may be allowed to enter only if they have agreed to abide by the provisions of this document, follow orders issued by the SHSO, and have been informed of the potential dangers that could be encountered in the areas.

Precautions will be taken to minimize contaminant dispersion during sampling activities at the water bore-out pits. BASIN & RANGE does not anticipate the need for a water truck because the drilling equipment and hand sampling techniques proposed for the site assessment program should not create a dust problem.

3.6 DECONTAMINATION PROCEDURES

Decontamination procedures will be consistent with site-specific conditions. The toxicity of contaminants or hazardous risk expected will govern the degree of decontamination that may be required. Highly toxic or skin-destructive materials will require full decontamination procedures; less hazardous substances will call for less stringent decontamination procedures.

Consideration will be given to the amount and location of contaminants on the protective clothing. Visual assessment will be the usual method of estimating the magnitude of risk. A thorough decontamination will generally be required if personal protective equipment is highly contaminated. Permeation or degradation of protective clothing could occur when hazardous materials remain on these surfaces for extended time periods. In addition, contamination on the upper areas of protective clothing could present a greater risk to the field personnel. Concentrations at this higher level could be more accessible to the breathing zone. The probability of skin contact also could be increased while personnel doff their upper clothing. Therefore, minimizing contamination on protective equipment and clothing will be a continual challenge during sampling activities.



Explanation:

- Center Point
- Traffic Control Entrance
- Traffic Control Exit
- Exclusion Boundary
- Decontamination Station Boundary

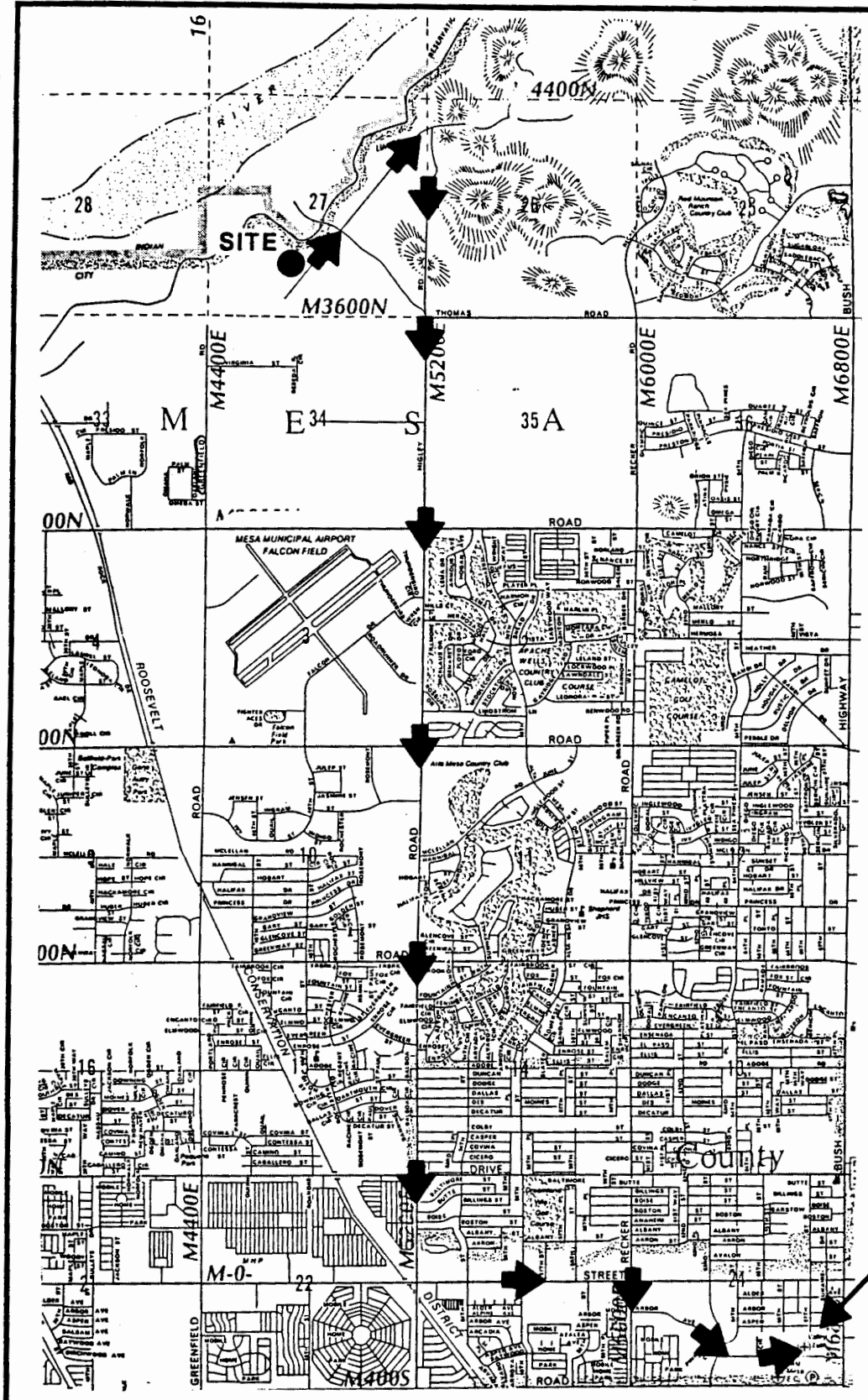
BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	CONTAMINATION REDUCTION SYSTEM	EXHIBIT 3 - 1
FILE NO.: 91-108-001	BASIN & RANGE	DATE: DECEMBER 4, 1991

The type of work that each person performs will govern the potential for hazardous material contact. Modification to decontamination protocol will be made on site as job functions dictate. Personnel periodically leaving potentially contaminated areas may or may not need decontamination depending on their reason for leaving. For example, personnel leaving potentially contaminated areas to pick up or drop off tools and immediately returning may not require decontamination. An individual leaving to change respirator cartridges may require some degree of decontamination. However, personnel exiting potentially contaminated areas for a break, lunch, or at end of shift will be completely decontaminated.

3.7 EMERGENCY RESOURCES

The following information will be posted in prominent locations for easy viewing by all field personnel during emergencies. In the event of an emergency (accident, illness, explosion, or hazardous situation at the site), emergency assistance will be obtained by the SHSO or other member of the team if the SHSO is unavailable. The route to the nearest hospital is provided in *Exhibit 3-2*.

Local Fire Department (Mesa)	911
Local Paramedic (Mesa)	911
Local Sheriff/Police (Mesa)	911
Local Medical Care	(602) 981-2000 Valley Lutheran Hospital 6644 Baywood Avenue Mesa, Arizona
Poison Control	253-3334 or 1-800-362-0101
Trauma Emergency Care	(602) 981-4200 Valley Lutheran Hospital 6644 Baywood Avenue Mesa, Arizona
Local Emergency Containment Service	(602) 784-4833 Chemical Disposal Company 2121 South Mill Avenue Tempe, Arizona



Source: Modified after Wide World of Maps, 1990.

BASIN & RANGE HYDROGEOLOGISTS, INC. PHOENIX, ARIZONA	SITE LOCATION AND ROUTE TO THE NEAREST HOSPITAL	EXHIBIT 3 - 2
FILE NO.: 91-108-001	BASIN & RANGE	DATE: DECEMBER 4, 1991

BASIN & RANGE HYDROGEOLOGISTS, INC.	
Mr. David L. Kirchner Project Director	(602) 840-3333
Mr. Philip J. Lagas Project Manager	(602) 840-3333
Kimball & Curry, P.C.	
Mr. David P. Kimball, III	(602) 222-5921
Mr. J. Stanton Curry	(602) 222-5922
Talley Defense Systems	
Mr. Donovan J. Jones	(602) 898-2204
Ms. Laurie J. Jacobson	(602) 898-2433
Mr. G. Scott Kerr	(602) 898-2341
Emergency Clean-Up/Containment	(602) 784-4833 Chemical Disposal Company 2121 South Mill Avenue Tempe, Arizona

3.7.1 Emergency Response Procedures

Emergency response procedures are intended to protect the health and safety of field personnel as well as employees of Talley. The procedures are designed to allow for reasonable precautions to avoid emergency situations and ensure a continuous work flow. Procedures will remain in effect for the duration of the sampling activity.

The SHSO and field personnel will have a mobile telephone during all field activities. Also, Talley personnel will carry two-way radios. In the event of an emergency, the SHSO and/or Talley personnel will be able to contact paramedics, local hospitals, and the fire department to obtain the necessary emergency response services. All accidents will be reported to the SHSO immediately and followed with a report.

Emergency response procedures will be initiated in response to the following situations:

- Fire on site
- Natural disaster
- Air emissions which pose an immediate danger
- On-site accident or equivalent failure that poses immediate danger to life or health.

The SHSO will have overall responsibility for the proper functioning of emergency response procedures. Specific activities will include:

- Monitor personnel protective equipment
- Monitor decontamination procedures
- Coordinate emergency response actions
- Institute a site-specific training program.

The primary response to hazards such as fire and other disasters is to assure an orderly evacuation of the site and notification of emergency personnel listed in this section.

3.7.2 General Safety Equipment

The following safety equipment and information will be provided on-site for use when needed. All equipment must meet federal and state OSHA requirements and shall be checked on a weekly time interval to ensure that it is in proper condition.

- First-aid kit
- 5-lb fire extinguisher (Type ABC - all purpose dry chemical)
- Hand cleaner and towels
- Clean water for washing or drench shower in case of an accident
- Emergency phone number (hospital, police, fire department, etc.)
- Additional equipment as required to provide adequate safety at the site.

4.0 SCHEDULE

Implementation of the SAP will commence within seven days following receipt of written notification to Talley of ADEQ's approval of the SAP. The following schedule is proposed for implementation of the SAP:

Activity	Estimated Schedule
Clearance survey of water bore-out pits	Week 1
Schedule subcontractors	Week 2
Collect soil samples	Week 3
Submit samples to laboratory	Week 3
Receive laboratory reports	Week 6
Submit final report to K&C	Week 12.

It is estimated that the field sampling activities could be completed in approximately one week. The analytical results would be received approximately three weeks following the laboratory's receipt of the samples. BASIN & RANGE will prepare a report, which could be submitted to K&C approximately six weeks following receipt of the written laboratory report. Therefore, BASIN & RANGE estimates that it will take approximately 12 weeks to complete the sampling program (including reporting) following authorization to proceed. However, if initial analytical results from shallow (i.e., 0 to 5 feet below existing surface grade) soil samples indicate the need to analyze additional soil samples collected at greater depths, an additional three weeks may be required to complete those analyses.

5.0 PROVISIONS FOR AMENDMENT

If additional sampling, requiring procedures not included in this SAP, needs to be performed at the water bore-out pits, an amendment to the SAP would be prepared and submitted to ADEQ.

6.0 REPORTING

During field operations, verbal activity reports will be given to K&C and Talley to apprise them of key findings and to discuss possible needs for modifications to the SAP. Upon completion of sampling and analysis, a report will be prepared and submitted to K&C. The report will contain, but not be limited to, the following:

- Site maps showing sample locations
- Tabular presentation of analytical results for each sample
- Analytical laboratory reports, including chain-of-custody forms
- Narrative description of field activities and observations
- Summary of analytical results and comparison to EPA toxicity characteristic MCCs and background concentrations
- Recommendations including provisions for remediation and/or closure, if warranted.

BASIN & RANGE estimates that the final report will be completed approximately 12 weeks following project initiation.

The analytical laboratory reports will include the analytical methods used, the date of analyses, each constituent detectable by the methods, corresponding detection limits, and each constituent detected. Laboratory QA/QC results will include matrix spikes, matrix spike duplicates, system blanks, and laboratory QC samples.

7.0. REFERENCES

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APPENDIX A

CHEMICAL COMPOUNDS TYPICALLY USED IN TALLEY'S AMMONIUM PERCHLORATE AND AMMONIUM NITRATE PROPELLANTS

APPENDIX A

CHEMICAL COMPOUNDS TYPICALLY USED IN TALLEY'S AMMONIUM PERCHLORATE AND AMMONIUM NITRATE PROPELLANTS

I. AMMONIUM PERCHLORATE PROPELLANT

Oxidizers

Ammonium Perchlorate
Potassium Perchlorate

Binders and Polymers

Carboxy-terminated polybutadiene (CTPB)
Hydroxy-terminated polybutadiene (HTPB)
Polysulfide
Polyvinyl chloride

Plasticizers

Dibutyl phthalate
Diisooctyl phthalate
Dioctyl adipate
Dioctyl azelate
Dioctyl phthalate
Isodeclyl perlargonate
Trioctyl phosphate

Combustion Modifiers

Carbon black
Iron oxide
Magnesium oxide
Oxamide

I. AMMONIUM PERCHLORATE PROPELLANT (Continued)

Metals

Aluminum

Minor Ingredients (Less than 2% by weight)

Agerite White (N,N dibetanaphthyl-para-phenylenediamine)
A02246 (2,2 methylene-bis-[4 methyl-6-tertbutyl phenol])
Dibasic lead phosphite
Ethyl 702 (4,4-methylene-bis-[2,6 di-tertbutyl phenol])
Iron naphthenate
Maleic Anhydride
MAPO
Triphenyl bismuth
Zirconium Carbide

II. AMMONIUM NITRATE PROPELLANT

Oxidizers

Ammonium nitrate

Binders and Polymers

Epoxy resin
Glycerol Polyglycidyl Ether
Polyisoprene
Polypropylene glycol

II. AMMONIUM NITRATE PROPELLANT (Continued)

Plasticizers

Dioctyl azelate
Polypropylene glycol

Combustion Modifiers

Carbon black
Ferric ammonium ferocyanide
Oxamide

Minor Ingredients (i.e., less than 2% by weight)

Agerite white
Dicumyl peroxide
Dicyandiamide
Lecithin
Manganese dioxide
Quinone dioxime
Sodium barbiturate
Sulfur
Wing Stay (p-Phenylenediamine)

APPENDIX B

TALLEY DEFENSE SYSTEMS' WASTE PROPELLANT COLLECTION AND BURNING PROCEDURES

TALLEY DEFENSE SYSTEMS, INC.

Mesa, Arizona

DOCUMENT 13713

Revision D

WASTE PROPELLANT COLLECTION AND BURNING

June 11, 1991

per ECO 24732

TABLE OF CONTENTS

REVISION LISTING

Symbol	ECO Number	Date
N/C	-----	06/03/87
A	22289	06/23/88
B	-----	06/19/89
C	-----	02/19/90
D	24732	05/01/91

1.0 GENERAL

a. This regulation applies to the collection and destruction of all waste propellants, pyrotechnic materials, and explosives at Talley Defense Systems, Inc.

b. The purpose of this regulation is to make all personnel involved with the collection and destruction of waste propellants, pyrotechnic materials, and explosives aware of the special problems and safety requirements required to cope with these problems.

NOTE: Any departure from these procedures will be conducted as a controlled test authorized by and under the direct supervision of the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist.

c. All personnel assigned to the collection operation shall attend an orientation class in the Safety Department prior to performing the first collection and destruction operation. The signed copy of the Record of Training shall be filed in the office of the Safety Director.

d. All persons assigned to Open Burning/Open Detonation (OB/OD) shall:

1. Complete the orientation class(s) as required in Section 1.0, paragraph (c) above which includes:
   (a) Hazardous Waste training as required by the EQHS.
   (b) Review of the current issue of this Document 13713.
   (c) Review of the current issue of the Basic Explosives Safety Training and Instruction Document.
   (d) Review of the current issue of Document 10310.

1.0 d. 2. Each operator shall receive hands on training by the Director of Safety and Environment Quality or Safety Engineer/Industrial Hygienist in handling the electric ignitors, connecting the ignitor leads to the firing leads, selecting and positioning starter material, placing electric ignitors in the starter material, operating the various methods of ignition, and handling misfires before the initial assignment to that task. See Section 6.0 h. and Appendix A for specific criteria.

NOTE: This training shall take place at a time when no explosives are present except for squibs required to train.

3. Have a current Arizona Class A Chauffeur's or CDL License.

4. Have a current D.O.T. Physical Examination Card.

e. Supplementary perimeter observers are required as described in Appendix D.

f. The burn ground at Talley Defense Systems is located approximately 1 mile northeast of Plant 2.

2.0 SAFETY REQUIREMENTS

2.1 Safety Equipment

a. Approved eye protection
b. Safety shoes
c. Flame-resistant coveralls without street clothes
d. Gloves (heavy duty leather)
e. Radios (two-way transceiver)
f. Portable telephone
g. Propane flashing torch
h. Water tank and pump
i. Shovels (2)
j. Water type fire extinguishers (2)
k. Broom (1)

2.2 Safety Regulations

a. All visitors shall wear safety glasses, flame resistant smocks and must remain at the firing site (Ignitor Hill) during the actual burning operations. The number of visitors shall be kept to an absolute minimum and will be permitted in the burn ground area only with permission of the Safety Director or Safety Engineer/Industrial Hygienist.

b. Good housekeeping is essential at all times when handling propellant of any type. Spillage must be eliminated. When spills occur, either during collection operations or on the burn truck, they shall be cleaned up immediately following the procedures described in the burn ground Contingency Plan (see excerpt in Appendix C). The burn truck must be maintained clean of propellant spillage at all times.

2.2 c. Under normal operating conditions, propellant waste shall be collected and disposed of on an as needed schedule.

d. Explosives limit - 10,000 lbs. in Burn Pits #2-#5 and/or 333 lbs. of Azide Propellant in Pits #1 & #6.

NOTE #1: **Quantities exceeding 5,000 lbs. will be under the direct supervision of the Director of Safety and Environmental Quality or the Safety Engineer/ Industrial Hygienist.**

NOTE #2: **Propellant quantities will never exceed the limits authorized in the most current permit(s) and standards issued by ADEQ for OB/OD.**

e. Personnel limit - Five (5) operators, five (5) visitors per 2.2.a. Visitors are to be kept to an absolute minimum and are authorized by the Safety Director or the Safety Engineer/ Industrial Hygienist.

f. Smoking or the carrying of matches or lighters during OB/OD activities is strictly prohibited including collection and transportation.

3.0 PROPELLANT WASTE - PREPARATION AND COLLECTION

SPECIAL NOTE: The following items present severe safety and/or regulatory hazards and must not under any circumstances be managed at the burn ground:

1. Metal Powders,
2. Neat Sodium Azide,
3. Any item which is not considered a reactive waste.

These items must be properly managed as hazardous/nonhazardous waste for off site disposal.

a. Prior to starting propellant collection, obtain the generator and extension cord, one (1) water type fire extinguisher, two (2) shovels, one (1) broom, load tie down rope, two-way radios, one portable telephone (for the observer), the propellant disposal order, and the proper manifest(s). (A second water type fire extinguisher is located at the Burn Ground.)

b. The collection, transportation, and preparation of scrap propellant for disposal at the burn ground must be done based on the materials stored for disposal.

NOTE: If any spills ever occur throughout the collection, transportation or unloading process, the Designated Observer shall be notified immediately and the spill swept up or shoveled up and recontainerized for the days burn per the observer's direction following the procedures described in the burn ground Contingency Plan (see excerpt in Appendix C).

3.0 c. Any material which is new or unfamiliar should not be collected. **OBTAIN COMPLETE IDENTIFICATION FROM THE AREA SUPERVISOR** and notify the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist. Do not pick up the material until an acceptable procedure and permits have been developed. The area supervisor shall inform the burn crew (with emphasis) as to any special hazards involved in the handling of the new or unfamiliar materials being picked up at that particular time. The burn crew shall notify the Director of Safety and Environmental Quality or the Safety Engineer/ Industrial Hygienist of the presence of any new or unfamiliar material.

d. Containers are provided for holding and collection of waste propellant and propellant contaminated trash.

1. Propellant collected at Plant #1 will be collected in 12H65 Fiberboard boxes. The boxes will be properly marked or assembled within a properly marked cargotainer (outside container).

   An accurate log of the Net Explosive Weight (NEW) of propellants by formulation must be kept for each cargotainer and individual boxes must be marked indicating the formulation and NEW.

2. Propellant collected at Plants #2, #3, #4 & #6 (6 noted for future reference only) will be in properly marked 12H65 boxes, lined cargotainers, fiberboard, poly or steel drums. Containers will be recovered for reuse if in good condition and uncontaminated.

   An accurate log of the NEW of propellants by formulation must be kept for each container at TDS plants.

3.0 d. 3. Class 1.1 Propellants and contaminated trash will be packaged in properly marked 12H65 boxes or steel drums as described in 2 above and must be transported separately.

NOTE: **Magnesium teflon propellant will be desensitized with #10 mineral oil and packaged in less than 1 lb. quantities in lined sealrites. No more than 5 lbs. NEW per shipping container.**

e. A properly completed manifest(s) and Land Disposal Restriction (LDR) form must be carried at all times while transporting waste propellant from Plants 1, 3, and 6. A LDR form is required for Plants 2 and 4.

f. Assure that all containers from Plant Numbers 1, 2*, 3, 4, and 6 are properly closed before loading onto the truck. This is to preclude any outside source of ignition (sparks, cigarettes, etc.) from entering the drums and meet various requirements.

* Bag is sealed.

g. All containers shall be tied securely to prevent shifting or tipping during transport to the burn ground.

h. Explosive "A" or "B" placards shall be displayed during transport of propellant materials. The signs shall be removed or covered as soon as the material is unloaded from the truck.

i. Upon the opening of waste propellant containers and/or removal of container contents, each container shall be visually inspected to verify that the material is waste propellant items. Any container holding questionable material shall not be placed in the pit. If the material is unknown, the Safety Engineer/Industrial Hygienist or the Director of Safety and Environmental Quality is to be notified immediately to identify the material. If the material is not waste propellant, it is to be returned to the source. The Environmental Quality/Health Specialist must be contacted for instructions on the return procedure.

Item 3.0.c. discusses the collection of new or unfamiliar material at the accumulation site. Waste is visually inspected upon pick up also.

j. The explosive labels on all containers, to be returned, will be covered or otherwise obliterated when the labeled hazard no longer exists.

4.0 BURN GROUND AND PIT CLEAN UP

a. General practice will be to conduct the cleanup on the next scheduled work day following every burn.

b. Re-entry of the Burn Ground proper after a successful burn must not be attempted until the next day at a minimum following non azide formulation burns and not until at least one hour after azide formulation burns.

1. Enter the burn ground cautiously and make sure there is no evidence of heat, fire, smoke, etc. Confirm that all pits are cold. If there is any evidence of heat, fire, smoke, etc. entry is prohibited except as specifically authorized by the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist.

2. Examine the area and pits for the presence of any material that might conceivably contain or be unburned propellant, explosive or pyrotechnic material. Place any such materials in plastic bags and tape or tie the bags shut. Place these closed containers (plastic bags taped or tied shut) in metal drums stenciled "Hazardous Waste, Reburn next burn." (See note at 6.0 e.)

   Examine the Burn Box(es) for the presence of any material that might conceivably contain or be unburned propellant, explosive or pyrotechnic material. Place any such materials in plastic bags and tape the bags shut. Place these closed containers in a metal drum stenciled "Burn Box Hazardous Waste, Reburn Next Burn" located between the two Burn Boxes.

All ash from the Burn Boxes is to be collected in a properly labeled drum for disposal at a hazardous waste TSDF.

3. Inspect all metal parts and ash in the pits. Containerize any suspect reactive materials as per 4.0 a.2 above.

4.0 b. 4. Remove all burned out scrap metal, cans, ash, etc., containerize and dispose of as directed by the Environmental Quality/Health Speacialist.

5. The foil covering the propellant pads in Pits #1 or #6 will be rolled and managed as described in 4.0.a.4. above.

6. A "Burn Ground Pit/Burn Box Clean Up Report" is to be completed and submitted to the EQHS immediately following the clean up.

5.0 BURN GROUND AND PIT PREPARATION

The following shall be done before every burn:

a. Verify all pits are cold per Section 4.0.

b. Select a clean pit, cleaned per Section 4.0 for the burn.

c. Flash the entire surface area of the selected pit or burn pad using the propane flashing torch. If there is any indication (sharp audible reports or hot sparks) of the presence of sensitive explosives, notify the Director of Safety or the Safety Engineer/Industrial Hygienist. They will provide specific directions which must be followed.

NOTE: The area of the selected pit and half of each adjacent pit or berm will be flashed when using pits 2-5. Wood stakes should be used to identify the area prepared ensuring that no propellant will ever be placed on an unprepared area.

d. Wet down of pits 2-5.

1. Shall take place after the pit has been flashed per Section 5.0 c.

2. Shall be done not more than one (1) hour before the collection of waste propellant begins.

3. Shall be thoroughly wet down including the side walls and approach ramp.

NOTE: The propellant pads in Pits #1 or #6 are not to be wetted.

5.0 e. Burn plate covering Pits 1 and 6:

1. The plate must be completely covered with heavy aluminum foil.

NOTE: Operators must be extremely careful with and around the foil as the edges are very sharp and may cause severe cuts.

f. Continuity testing

1. The pit operator shall determine the pit or pits to be used and conduct continuity tests as follows:

(a) Provide an adequate length of firing lead to reach the anticipated propellant pile(s) location(s) and attach the leads from ignitor hill making a continuous run.

(b) Twist the ends of the leads together to complete the circuit. If more than one pit is to be fired, the leads must be connected and tested individually.

(c) The designated observer will make the firing lead connection by inserting the Burn Ground leads and the personnel shelter leads into the firing circuit on ignitor hill.

(d) Attach the continuity tester to the blade leads of the firing box. Turn the key switch to the on position and depress the firing button. A red light on the continuity testor indicates a complete circuit.

5.0 f. 1. (e) The observer will instruct the operator to disconnect the pit leads and verify that the circuit is open (the firing button must be depressed).

(f) When the open circuit is verified, the observer will instruct the operator to again connect the leads and check for a complete circuit as in (e) above.

(g) The observer will notify the operator of the outcome of the test(s).

(h) The observer will disarm the firing box by turning the key switch to the off position and removing the firing key.

(i) The observer will move the Burn Ground leads to the ground circuit on ignitor hill.

(j) The observer will remove the firing key and deliver it to the operator <u>immediately</u>. The operator will maintain possession of the firing key until the OB/OD activity is complete.

<u>NOTE</u>: **All paragraph 5 (Burn Ground and pit preparation) requirements must be met prior to proceeding with the OB/OD Activity as described beginning at Section 6.0 paragraph d of this document.**

6.0 PROPELLANT DISPOSAL AND BURNING

a. Authorization to burn waste propellant must be obtained prior to the activity from the Fire Prevention Section of the Mesa Fire Department (FPS/MFD) and the Maricopa County Bureau of Air Pollution Control (MCBAPC).

b. To obtain permission, proceed as follows:

1. The day shift guard at Plant No. 2 on the day of the planned burn shall call the the MCBAPC and the FPS/MFD to obtain authorization to burn. The security guard will provide a four hour time window and a target burn time(s) to the FPS/MFD. (Calls cannot be made before 8:00 AM.)

2. If authorization is obtained, the burn crew shall proceed with collection and transport of scrap propellant to the burn ground. If permission is not granted, the scrap materials shall remain where they are until permission is granted. The Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist must be notified of any refusal or special restrictions.

c. When the request to burn has been authorized and the HWMH's notified, the guard shall then notify the Rural Fire Department, the Mesa Fire Department (Head Dispatcher), the Mesa Fire Department (Station 8), the Maricopa County Sheriff's Office (Shift Supervisor), and the McDonnell Douglas Tower regarding the burn and the estimated time window.

6.0 d. When Section 6.0, paragraphs (a.) and (b.) and Clean Up and Preparation are completed per paragraphs 4.0 and 5.0 the burn crew shall collect and transport the scrap propellant to the burn ground as planned by the Director of Safety and Environmental Quality, the Safety Engineer/Industrial Hygienist or the Environmental Quality and Health Specialist. When the operators are ready to begin collection of waste propellant, the observer will read and document the wind direction and speed.

NOTE: Thirty minutes before the predicted ignition time, the observer shall confirm by radio that the three (3) supplementary observers are at their posts and Appendix D is implemented.

e. Drive to the burn ground and load the pit and disperse the bags of propellant as follows:

NOTE 1: Sodium azide propellant, sodium azide propellant contaminated trash, etc. shall be placed and burned exclusively in Pits #1 or #6. Non azide formulations will never be placed or burned in Pits #1 or #6. Likewise sodium azide propellant and contaminated trash will not be burned in Pits #2-#5.

NOTE 2: All propellant formulations containing RCRA regulated metals are burned in the Burn Boxes. The Propellant Disposal Order, completed by the Director of Safety and Environmental Quality, SE/IE or the EQHS, will indicate that the waste is to be burned in the Burn Boxes.

NOTE 3: The activities observer will monitor the Supplementary Perimeter Observers (SPO's) as dictated in Appendix D.

6.0 e. 1. Remove all paperwork, portable radio (operators only) and personal items at the Burn Ground entry gate.

2. Open the supply cabinet giving access to the first aid supplies.

3. Align the truck with the pit and stop 50' (minimum) outside the pit. Side racks must be removed from the truck and the radio placed in an area such that reception can be heard but clear of the pit.

4. Off load the closed propellant containers providing a minimum of 10' separation between containers and/or previously deposited closed containers. Containers must not be opened while the truck or forklift are inside the Burn Ground proper.

NOTE: Azide propellant items will be placed on the steel propellant pad only.

5. The containers must be managed so that the operators have a continuous route of egress.

6. Any spillage of propellant and/or propellant contaminated wastes on the truck must be picked up and the surface cleaned of any residues before the off loading can continue.

7. After the truck is unloaded, drive the truck away from the pit a minimum of 50 feet to reinstall the sideracks. Drive the truck outside the Burn Ground gate before opening containers.

6.0 e. 8. Return to the pit and hand carry the propellant to the pile. Spread or position the bags of scrap propellant as needed to insure complete burning. Place Plant No. 2 propellant and other less sensitive propellant items on top to assure ignition and efficient burning.

NOTE: Sodium Azide propellant will be packaged (50 lb. maximum) in 35 gal. steel drums. All propellant will be in granular form (no disks) and in a single conductive bag. The propellant is not to be removed from the drum. The drum will be placed on the foil covering the burn plate. A maximum of 100 lbs. (2 drums) may be burned at one time.

9. Empty containers must be reloaded onto the truck outside the Burn Ground proper and returned to the plant(s) from which they came if reuseable. Non reuseable drums will be collected for disposal or recycling.

f. Class 1.1 waste must never be managed with other propellant items. Manage Class 1.1 waste following the requirements of Section 3.0 d.3.

1. TAL-I 12

(a) A large bed of excelsior must be made to insure ignition and complete burning of the oil desensitized TAL-I 12.

(1) Pull or tear apart the bails of excelsior (2 minimum) making a large loose pile. The loose pile is needed for good air circulation and complete burning.

(b) The containers of TAL-I 12 must be opened and all the contents pulled apart providing the maximum exposure of each item to the fire.

6.0 g. The electric igniters for ignition of the pits (2) must be obtained from the service magazine at Plant #2.

1. The ignitors may be obtained by either the burn crew or by the activities observer while the burn crew is out of the burn ground area (two persons are required).

2. The electric ignitors must be wrapped individually in foil and transported in the red ammo box. The Magazine Log must be updated to reflect an accurate on hand quantity. This box must be secured in the cargo area of the truck whenever transporting ignitors.

3. The electric ignitors will be placed just inside the Burn Ground gate until the operator is ready to prime the pits.

h. Prepare the scrap propellant in the burn pit for ignition as follows:

1. The operator will remain at the burn ground, the activities observer will move to the observation point and the attendant will obtain the final wind speed and direction information from Plant #2 and return to the personnel shelter.

NOTE: The operator cannot begin the priming process until the observer is at the observation point and verifies by hand signal (hand sweep from vertical to the side) that the pit leads are grounded.

6.0 h. 2. One person only (an operator trained in destruction) shall be in the burn pit(s) and set the electric ignitors.

3. Before any work with the electric ignitors, the operator must contact the guard at Plant No. 2 on the two-way radio and notify him/her that the burn crew will be on radio silence until the pit(s) are primed and the operator has exited the Burn Ground. Leave the radio on for reception, but do not transmit until after leaving the Burn Ground. Emergency receptions can be responded to with adequate separation of the radio from the electric ignitor (a minimum of 100 yards).

4. The observer will verify that the pit leads are grounded at ignitor hill and advise by hand signal to the operator.

5. Uncoil the leads of the electric ignitors by hand. DO NOT wave or whip the leads to uncoil them. (Refer to Appendix A.)

6. Remove the shunt from the electric ignitor leads and connect them to the firing leads. (Refer to Appendix A.)

7. Insert the electric ignitor(s) in the starter material. Cover the starter material sufficiently with other propellant to assure good ignition of the propellant bed. (Refer to Appendix A.)

8. Place an adequate quantity of effective starter material in direct contact with the scrap propellant to be burned.

6.0 h. 9. Upon completion of the priming process, the operator will walk to the Burn Ground gate, close the supply cabinet, exit the Burn Ground, lock the gate, notify the guard at Plant #2 that the priming process is complete and that the control tower at Falcon Field should be notified that the initiation of the burn is expected within the next five (5) minutes and drive to the personnel shelter .

NOTE: **The burn cannot be initiated until the guard verifies that Falcon Tower has been notified.**

10. After the operator has evacuated the Burn Ground, the observer will move the pit leads from the ground terminals to the firing terminals on ignitor hill then proceed to the personnel shelter. The operator or attendant will park the vehicle with the generator in it just below the personnel shelter, run the extension cord from the generator to the personnel shelter, make the connection of the firing box to the extension cord, and start the generator.

11. At the personnel shelter, the observer will visually, audibly and by radio to the Supplementary Perimeter Observers assure that all aircraft, vehicles, trespassers, etc. are clear of the safety zone. Any questionable wind characteristics should be referred to the Director of Safety and Environmental Quality or the Safety Engineer/ Industrial Hygienist.

12. The operator trained in destruction shall contact the guard at Plant No. 1 on the two-way radio to notify him that he is "Preparing to Burn."

6.0 h. 13. Take cover.

(a) All operators and activity observer(s) inside the personnel shelter.

(b) The observer shall verify by radio that the SPO on hill 1477 is in the designated location on the east side of the hill, that both canal observers are in their designated positions and that the safety zone is clear.

14. The operator will initiate the burn by inserting the pit leads into the firing box, and depressing the red button.

NOTE 1: See Section 6.0, paragraph (i.) for misfires.

NOTE 2: The use of electric ignitors or matches, as described above, is the only approved method for igniting anything in the burn pit. Do not use any other method.

15. Immediately upon observation of ignition, the operator will notify the guard that there is a "Good Burn." All operators and observers at the personnel shelter will remain under cover for at least five (5) minutes or until the flames have receded (whichever is longer).

16. Upon leaving cover, the observer will broadcast "All Clear" on the two-way radio and remain at Ignitor Hill and observe the burn. (Do not approach the burn pit. The reason for observation is to determine that no brush fires have started in the area.) Return the leads to the box on ignitor hill and close the box before leaving.

6.0 h. 17. If brush fires have started, notify the guard at Plant No. 2 by the two-way radio immediately. Fight brush fires which are firing site (Ignitor Hill) distance from the burn pit using the shovels and water fire extinguishers. Do not fight brush fires which are less than firing site (ignitor Hill) distance from the burn pit until the burn pit fire has receded extensively.

18. When the burn pit fire has receded extensively, no brush fires have occurred or are extinguished and at least 30 minutes have passed since ignition, the observer will notify the guard at Plant No. 2 that all personnel are leaving the burn ground area.

NOTE 1: The operators may depart after the five minute undercover wait and verification of no spot fires.
NOTE 2: The road gate must be locked upon final exit.

19. Return the containers (if any) to all plants.

20. Return the equipment to the appropriate storage location(s).

i. If the scrap propellant in the burn pit fails to ignite (misfires) after application of power from the electric firing device, perform the following:

1. Immediately disconnect the firing box. Notify the Plant #2 Guard and the Director of Safety and Environmental Quality, or the Safety Engineer/ Industrial Hygienist that there is a "Misfire."

2. Remain at the personnel shelter. Do not approach the pit for a minimum of 30 minutes.

NOTE: If more than one (1) pit was primed for burning and one (1) pit did not ignite notify the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist and do not approach under any circumstance. The following day, obtain permission to burn per Section 6.0, paragraph (a.) and paragraph (b.), step (1.). Complete the misfire procedure per Section 6.0, paragraph i under the direct supervision of the Director of Safety and Environmental Quality or Safety Engineer/Industrial Hygienist. Follow the notification procedure as described in Section 6.0, paragraphs c. and d. Fire the pits per Section 6.0, paragraph h.

3. The observer is to ensure that the pit leads are grounded at Ignitor Hill, advise the operator of the verified grounding and remain at Ignitor Hill to monitor the operator while at the Burn Ground as follows.

(a) One (1) trained operator only shall approach the misfired pit. If there is any evidence of fire, retreat until all evidence of fire is gone.

(b) Remove the electric ignitors from the propellant pile by gently pulling the leads from 5'-10' away from the pile. (If necessary, propellant laid on top may be moved.) Check to see if the ignitors fired. Move well clear of the propellant pile, disconnect the ignitors from the firing leads and twist the wires together.

(c) Check the circuit, Section 5.0, paragraph e., step 1. Repair the circuit and check per Section 5.0, paragraph e., step 1. Using a new electric ignitor, attempt to ignite the pit following all requirements described in Sections 5.0 & 6.0. The original ignitor will be placed on the pile for destruction.

NOTE: Items i.5 & .6 must be conducted in the presence and under the direct supervision of the Director of Safety and Environmental Quality and/or the Safety Engineer/Industrial Hygienist.

7.0 PROPELLANT DISPOSAL AND BURNING ACTIVITIES OBSERVER

a. All actual propellant disposal and burning activities as described in Section 6.0 above must be observed and coordinated with a third person observer at the site.

b. The observer must be trained and authorized in this activity by the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist.

c. The observer is obligated to follow the activity protocol as outlined in the attached checklist (Appendix B).

d. The observers charter is to insure that all procedures are followed as outlined in this document (13713), identify any unusual circumstances and take appropriate action as necessary to insure the safety all employees involved.

e. The observer is responsible for establishing a second line of communication, i.e., portable telephone, during the propellant disposal activity.

f. The observer is responsible to arrange for and supervise the SPO's as required in Appendix D of this document.

g. The observer is responsible for collection of all burn related paperwork which includes the Disposal Order, Burn Report, Observer's Checklist, Guard Report, Container/Drum Logs, Manifests, and Land Disposal Restriction form. The observer is responsible for delivery of such paperwork to the EQHS in a timely manner following the activity.

APPENDIX A

APPENDIX A

Electric igniter and starter material placement criteria statement.

I. Preparation

A. Electric Ignitors

1. DuPont S-116 ignitors will be used whenever possible.

2. BKNO3 matches or other sources may be used only when authorized by the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist.

B. Storage of Ignitors

1. At Plant #2, Magazine #3 for electric ignitors.

2. At Plant #1 Production or Plant #2 Magazine #3 for BKNO3 matches.

C. Transportation of Ignitors

1. Electric ignitors or matches must be individually wrapped in foil and transported in the Red Ammo Box.

2. The Ammo Box must be secured in the cargo area of the transporting vehicle in such a way that the box could not be inadvertently lost or damaged whenever transporting ignitors. Ignitors or matches will never be transported in the occupant area of any vehichle.

3. Ignitors may be transported by the operator in the delivery vehicle or by the activities observer.

4. Ignitors must be left at the Burn Ground Gate until the onset of the pit priming operation.

D. Starter Material

1. TAL-1101 (Pits 1 & 6 only)
2. AP Propellants (Pits 2-5 and burn boxes)
3. AN Propellants & Ignitor materials (Magnesium Teflon, BKNO3, etc. are not suitable and must not be used for this purpose.

II. Pit Priming

A. Evacuation

1. All personnel except the operator (trained) must evacuate the Burn Ground before the priming operation can begin.

2. The operator is not to begin the priming process until visual confirmation that the observer is in position at the observation point.

B. Notification

1. The operator must notify, by radio, the Plant #1 Security Guard of his intentions to begin pit priming and advise that he will maintain radio silence during this operation.

C. Continuity Testing

1. Must be conducted prior to the priming process as described in 5.0 e. of Document 13713 Revision D.

D. Wiring

1. Wiring of the ignitors must be done well clear (outside) of the pit away from the propellant.

2. Attach the ignitors to the firing leads as described in Document #13713 Revision D 6.0 h.5. and h.6.

3. The ignitor wires must be extended so that the ignitor will be as far to the side of the operator as possible when making the wire connections.

E. Priming Azide Propellant Formulations

1. The ignitor must be placed in intimate contact (at the surface) with the propellant in the drum.

F. Priming Other Propellant Formulations

1. The priming of the starter material must be done at or near the outer edge of the propellant pile.

2. The ignitors must be placed in intimate contact with the starter material.

3. The primed starter material must be placed in a predetermined suitable location to achieve good exposure of the propellant bed to fire.

4. The ignitors must be trapped (blocked) in place in the starter material to prevent blowout.

IV. Departure

A. Security

1. The storage cabinet must be closed by the pit operator immediately before departure.

2. The burn ground gates must be closed and locked upon departure.

B. Notification

1. When the pit operator is a minimum of 100 yards from the burn pits, the Plant #2 security guard must be notified. that the priming of the pits is complete and that Falcon Tower should be notified of the upcoming burn (within five minutes).

A P P E N D I X B

Appendix B

OB/OD ACTIVITIES, FACILITIES & EQUIPMENT CHECKLIST

(To be completed by the Assigned Observer for each OB/OD Activity)

Date: __/__/__ Time Window: From _____ To _____ Target _____ Burn # _____

(Circle the Observer, Operators and SPO's from the following approved lists.)

OBSERVERS	OPERATORS	SUPPLEMENTARY PERIMETER OBSERVERS		
Bo Baxter	Rick Ferguson	Berry Brown	Stan Hollar	Ray Rupert
Scott Kerr	Larry Guy	Danny Buckland	Rick Isbell	Fred Sabori
Rick Ferguson	Jeff Krivanec	Frank Duarte	Bob Jenkins	Kris Sleighter
Larry Guy	Donovan Jones	Leo Evans	Murray Johnson	Bob Tanner
Jeff Krivanec	Scott Kerr	Mike Flatoff	Rick Martinez	Richard Velasquez
Laurie Jacobson		Jim Ginnan	Max Richardson	Jerry Ward
Donovan Jones				

(Place an X in the block as appropriate.)

I. Training

A. All Pit operators have received Basic Explosives Safety Training & Instruction [ ]

B. All Pit operators have received OB/OD Training (Document #13713) [ ]

II. Equipment (Each item must be in good condition.)

A. Water type fire extinguishers (2):
   1) One at the burn ground gate; and, [ ]
   2) One on the delivery vehicle. [ ]

B. Shovels (2) on the delivery vehicle. [ ]

C. Broom (1) on the delivery vehicle. [ ]

D. Coveralls (every operator) [ ]

E. Safety glasses (every operator) [ ]

F. Gloves (heavy leather) [ ]

G. Two-way radio [ ]

H. Portable telephone [ ]

III. Pit/Burn Box Preparation

A. Clean (free of residues) Pit #(s) _____ Box # _____ [ ]

B. Flame brushed with 1/2 pit overlap to open sides Pit #(s) _____ (N/A for Burn Box) [ ]

C. Water wetted with 1/2 pit overlap to open sides Pit #(s) _____ (N/A for Burn Box) [ ]

IV. Propellant Delivery

A. No smoking materials, matches or lighters in possession or in vehicle. [ ]

B. Plant #2 Security Guard notified of each entry and departure of the Burn Ground Area. [ ]

C. Proper manifests completed. [ ]

D. Paperwork, radio and personal effects removed from delivery vehicle before entering the Burn Ground. [ ]

E. Burn Ground gate open. [ ]

F. Side racks removed. [ ]

G. Preplanned egress route established and maintained. [ ]

H. No excessive rough handling of propellant items. [ ]

I. No azide propellants in Pit #s 2-5. [ ]
   No propellant items other than azides in Pits #1 & #6. [ ]

J. Truck bed inspected for propellant residues [ ]

K. New Start Date Tabs applied and Explosive Labels covered. [ ]

L. Side racks reinstalled and all equipment moved outside the Burn Ground Gate. [ ]

M. All SPO's in position 1/2 hour before burn event. [ ]

V. Application of Ignition Devices

A. Operator is certified for this operation by the Director of Safety & Environmental Quality or the Safety Engineer/Industrial Hygienist. [ ]

B. All employees have evacuated the Burn Ground except the operator. [ ]

C. The operator has in his possession the sole firing switch key. [ ]

D. Plant #2 Security notified for radio silence. [ ]

E. The portable radio is in the possession of the operator (in the delivery vehicle). [ ]

F. The observer has indicated to the operator that the system is grounded and the operator has acknowledged. [ ]

G. Burn Ground gate locked upon final exit. [ ]

VI. Ignition

A. Falcon Field Tower notified of upcoming OB/OD activities. [ ]

B. Verify SPO's in safe position. [ ]

C. Airspace checked for aircraft. [ ]

D. All personnel inside the personnel shelter. [ ]

E. Report burn ignition to Plant #2 Security. [ ]

F. Report misfires to Plant #2 Security. [ ]

G. Any attempt to initiate the burn from other than the personnel bunker or investigate a misfire must be done only under the supervision of the Director of Safety and Environmental Quality or the Safety Engineer/Industrial Hygienist. [ ]

VII. Departure

A. All personnel inside the personnel shelter for a minimum of 5 minutes after ignition. (Supplementary Observers must remain in position for a minimum of one half hour after ignition.) [ ]

B. Survey the Burn Ground Area for spot fires only after the active flames have subsided. [ ]

C. Report any spot fires to the Plant #2 Security Guard. [ ]

D. When appropriate the Observer broadcasts "All Clear". [ ]

E. All SPO's in position 1/2 hour after ignition. [ ]

F. Burn Ground gate locked. [ ]

G. Advise Supplementary Observers of their appropriate departure one half hour after ignition. [ ]

Wind Data: (Taken at Plant #2)

1. Prior to OB/OD Activity Start: Time: _____ Direction: From _____° Speed: _____ MPH

2. Prior to Actual Ignition: Time: _____ Direction: From _____° Speed: _____ MPH

NOTE: Direction observations between 235° and 275° or speed in excess of 15 mph requires the approval of the Director of Safety and Environmental Quality or the Safety Engineer/ Industrial Hygienist to proceed.

SPO's in Position Time: _____ SPO Activities Notes: _____

ACTUAL IGNITION TIME: _____ _____

SPO's Departure Time: _____ _____

SPO Time Required: _____/ea. _____

OBSERVER'S SIGNATURE: _____

A P P E N D I X C

All personnel providing information to outside response groups will do so after the EC indicates the need (see Section 9 for content of information to be given). The EC will be the contact for outside response groups unless circumstances prohibit. The EC will assign reporting duties if necessary.

The EC must immediately notify the National Response Center (1-800-424-8802) if a "reportable quantity" (RQ) has been released as described in Appendix C.

Containment and Control Activities [264.52(a) and 264.56(g)]

The TDS Burn Ground Facility and Document 13713 are designed to minimize potential hazards to personnel, and to contain released materials.

Release

An explosive waste release would occur due to a leaking container, or a drum accidently being over-turned. Cleanup of explosive wastes is as follows:

- The solid portion is removed and recontainerized first using a non-sparking shovel

- The remaining liquid portion (if any) and contaminated soil is then removed and containerized (soil covering removed until contamination no longer visible)

- Release cleanup material is disposed of on-site via open burning operations

Personnel preforming release cleanup are to be Hazardous Waste/Material Handlers (HWMH) and shall wear the flame retardant protective clothing and safety glasses.

APPENDIX D

APPENDIX D

Supplementary Perimeter Observer (SPO) Operating Procedure.

I. Purpose

A. To provide visual observers in three (3) locations to prevent members of the public from approaching within 1250 ft. of the burn ground during a burn event.

1. Location

a. Where the 1,250' arc from the center of the burn ground intersects the canal road on the north side of the canal at the north and at the south.

b. On top of the mountain with the 1,477' elevation to the east of the burn ground.

II. Selection

A. SPO's will be selected from and assigned by the Manufacturing Departments of Plants 1, 2, 3 and 4.

B. While assigned to a burn activity, the SPO will be supervised by the Activities Observer.

III. Training

A. Document 13713 (in general)

B. Basic Explosives Safety Training & Instruction (current issue)

C. This Appendix D in detail.

D. Hazardous Waste Training as required by Environmental Quality and Health Specialist.

IV. Equipment

A. Portable two-way radio for each of the three (3) SPO.

1. The SPO on top of the 1477' mountain is identified for radio purposes as SPO-1.

2. The SPO's on the canal road are identified for radio purposes as SPO-North and SPO-South.

V. Procedure

A. All three (3) SPOs shall be in place with two-way radios thirty minutes before, during and 30 minutes following each burn event.

1. The SPOs on the SRP right-of-way shall attempt to detain, by nonforceful means, all persons from entering the 1,250' clear zone when there would be exposure to the burn event. At times when the event is not imminent (10 or more minutes) or has passed (minimum 5 minutes), the SPO may coordinate direct passage through and out of the clear zone with the other SPO.

2. The SPO on top of the 1,477' mountain shall stop the burn event by radio message to the observer when persons are seen that are in or could move within the 1,250' arc during the burn event.

B. The SPO on the 1477' mountain shall move to the safe location on the East side of the observation point when so directed by the observer and remain there until the "All Clear" is given by the observer (minimum of 5 minutes).

C. The SPO's on the canal road will maintain their position at the 1250' marker throughout the operation.

VI. Precautions

A. The Observers may encounter:

1. Rough, steep, uneven terrain.

2. Sometimes disagreeable weather conditions (heat, cold, etc.).

3. The possibility of insects, snakes and other wildlife natural to the area.

The Observers must pay particular attention to the hazards associated with this area and take the necessary precautions to prevent injury.

APPENDIX C

ANALYTICAL RESULTS FROM PREVIOUS SAMPLING CONDUCTED AT THE WATER BORE-OUT PITS

C-1. LABORATORY REPORT FOR SAMPLES COLLECTED DURING FEBRUARY, 1990

RECEIVED MAR 2 1990

SCS ANALYTICAL LABORATORY
2860 WALNUT AVE.
LONG BEACH, CALIFORNIA
(213) 595-9324
FAX (213) 595-6707

Talley Defense Systems, Inc.
3500 N. Greenfield Road
Mesa, AZ 85201

Attn: Laurie Jacobson

February 21, 1990

LABORATORY REPORT

Samples: Three (3) solids and one (1) water sample, received 2/12/90, analyzed 2/20/90. Reference your P.O. number 53365.

Sample ID	EP TOX Cd (7130)	Cr (7190)	Pb (7420)	
	mg/L			
TDS1-12/20/89-LJ	2.7	ND	ND	– Plant #1 Sand Blast Residues
TDS3-2/1/90-GW-1	0.55	ND	ND	– Plant #3 Water Bore-out Solid Residues
TDS3-2/1/90-GW-2	0.11	ND	ND	– Plant #3 Water Bore-out Pit Water
TDS1-2/1/90-LJ	79.5	15	ND	– Plant #1 Bead Blast Residues
Detection Limit	0.008	0.025	0.15	

David Sincerbeaux
Chemist

Curtis B. Jenkins
Vice President, Analytical Srv.

tally2.rep

C-2. LABORATORY REPORT FOR SAMPLES COLLECTED DURING AUGUST, 1990

SCS ANALYTICAL LABORATORY
2860 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-9324
FAX (213) 595-6709

Talley Defense Systems, Inc.
3500 N. Greenfield Road
Mesa, Arizona 85211

Attn: Ms. Laurie Jacobson

September 6, 1990

LABORATORY REPORT

Sample: Two (2) solid samples from Talley Defense, refer to LJJ-0446, and purchase order 53810. Received 8/30/90 and analyzed 9/6/90.

Sample ID	TCLP Metals Cd (6010)	Cr (6010)	Pb (6010)
	mg/L		
TDS3-8/20/90-JK-1 -Water Bore Out Drum Solids	ND	ND	ND
TDS3-8/20/90-JK-2 -Water Bore Out Drum Solids	ND	ND	1.0
Detection Limits	0.2	0.05	0.5

ND - Not Detected

David Sincerbeaux
Chemist

Curtis B. Jenkins
Vice President
Analytical Services

tally12.rep

C-3. LABORATORY REPORT FOR SAMPLES COLLECTED DURING NOVEMBER, 1990

SCS ANALYTICAL LABORATORY
2860 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90
(213) 595-9324
FAX (213) 595-6709

Talley Defense Systems, Inc.
3500 N. Greenfield Road
Mesa, Arizona 85211

Attn: Ms. Laurie Jacobson

November 20, 1990

LABORATORY REPORT

Sample: Ten (10) Soil samples from Talley Defense Systems received 11/13/90, analyzed 11/16/90.

Sample ID	Cd (6010)		Cr (6010)	Pb (6010)	NO_3^- (353.2)
	mg/kg				
TDS3-11/9/90-LJ-1-1 surface	ND	Pit #1	6	12	151
TDS3-11/9/90-LJ-1-2 1 ft	6		9	210	97
TDS3-11/9/90-LJ-1-3 2 ft	ND		3	39	64
TDS3-11/9/90-LJ-1-4 3 ft	ND		5	7	55
TDS3-11/9/90-LJ-2-1 surface	7	Pit #2	13	192	123
TDS3-11/9/90-LJ-2-2 1 ft	26		9	6	98
TDS3-11/9/90-LJ-2-3 2 ft	22		8	6	51
TDS3-11/9/90-LJ-2-4 3 ft	17		7	15	63
TDS3-11/9/90-LJ-3-1 surface	ND	Back-ground	7	12	32
TDS3-11/9/90-LJ-3-2 1 ft	ND		7	6	19
Detection Limit	4		1	10	0.5

ND= NOT DETECTED

David Mikesell
Chemist

Lam V. Ho PhD, REP
Laboratory Director

tally24.rep

TALLEY DEFENSE SYSTEMS, INC.

INTEROFFICE MEMORANDUM RECEIVED JAN 14 1991

TO: Donovan Jones DATE: 11 January 91

FROM: Dawn Edmundson REFER TO: DME-0003

SUBJECT: Samples From ~~Burn Ground~~ Bore-out Pit Samples collected November 1990

	SAMPLE NUMBER	ppm AP/Kg Soil
Pit 1	1-1 surface	4440
	1-2 1 foot	18,000
	1-3 2 foot	1830
	1-4 3 foot	615
Pit 2	2-1 Surface	705
	2-2 1 ft	105
	2-3 2 ft	152
	2-4 3 ft	170

The weighed samples were extracted in 100 ml of water. The specific ion detection method was an Orion perchlorate ion electrode with a Koss single junction reference electrode. A three point calibration preceded the measurements.

Dawn Edmundson
Project Chemist

DME/vls

cc: Mel Steinle

C-4. LABORATORY REPORT FOR SAMPLES COLLECTED DURING DECEMBER, 1990

SCS ANALYTICAL LABORATORY
2960 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-9324
FAX (213) 595-6209

Sample I.D.: Water Bore Out
Date Received: 12/17/90
Date Extracted: 12/18/90
Date Analyzed: 12/19/90
Matrix: Water
Project #: 0689044
File #: tally26.rep

	Compound	Result ----ug/L (ppb)	D.L. ------
83-32-9	Acenaphthene	ND	10
208-96-8	Acenapthylene	ND	10
120-12-7	Anthracene	ND	10
92-87-5	Benzidine	ND	50
56-55-3	Benzo(a)Anthracene	ND	10
205-99-2	Benzo(b & k)Fluoranthenes	ND	10
191-24-2	Benzo(ghi)perylene	ND	10
50-32-8	Benzo(a)pyrene	ND	10
65-85-0	Benzoic Acid	ND	50
100-51-6	Benzyl Alcohol	ND	10
111-91-1	Bis(2-Chloroethoxy) Methane	ND	10
111-44-4	Bis(2-Chloroethyl) Ether	ND	10
39638-32-9	Bis(2-Chloroisopropyl) Ether	ND	10
117-81-7	Bis(2-ethylhexyl) Phthalate	ND	50
101-55-3	4-Bromophenyl Phenyl Ether	ND	10
85-68-7	Butyl Benzyl Phthalate	ND	10
106-47-8	4-Chloroaniline	ND	10
59-50-7	4-Chloro-3-Methylphenol	ND	10
91-58-7	2-Chloronaphthalene	ND	10
95-57-8	2-Chlorophenol	ND	10
7005-72-3	4-Chlorophenyl Phenyl Ether	ND	10
218-01-9	Chrysene	ND	10
53-70-3	Dibenzo(a,h)anthracene	ND	10
132-64-9	Dibenzofuran	ND	10
84-74-2	Di-N-Butyl Phthalate	ND	10
95-50-1	1,2-Dichlorobenzene	ND	10
541-73-1	1,3-Dichlorobenzene	ND	10
106-46-7	1,4-Dichlorobenzene	ND	10
91-94-1	3,3'-Dichlorobenzidine	ND	20
120-83-2	2,4-Dichlorophenol	ND	10
84-66-2	Diethyl Phthalate	ND	10
105-67-9	2,4-Dimethylphenol	ND	10
131-11-3	Dimethyl Phthalate	ND	10
534-52-1	4,6-Dinitro-2-Methylphenol	ND	50
51-28-5	2,4-Dinitrophenol	ND	50

D.L. = Detection Limit
ND = Not Detected

SCS ANALYTICAL LABORATORY
2860 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-5324
FAX (213) 595-6705

Sample I.D.: Water Bore Out
Date Received: 12/17/90
Date Extracted: 12/18/90
Date Analyzed: 12/19/90
Matrix: Water
Project #: 0689044
File #: tally26.rep

Compound		Result ----ug/L (ppb)	D.L. ------
121-14-2	2,4-Dinitrotoluene	ND	10
606-20-2	2,6-Dinitrotoluene	ND	10
117-84-0	Di-N-Octyl Phthalate	ND	10
206-44-0	Fluoranthene	ND	10
86-73-7	Fluorene	ND	10
118-74-1	Hexachlorobenzene	ND	10
87-68-3	Hexachlorobutadiene	ND	10
77-47-4	Hexachlorocyclopentadiene	ND	10
67-72-1	Hexachloroethane	ND	10
193-39-5	Indeno(1,2,3-cd)pyrene	ND	10
78-59-1	Isophorone	ND	10
91-57-6	2-Methylnaphthalene	ND	10
95-48-7	2-Methylphenol	ND	10
106-44-5	3 & 4-Methylphenols	ND	10
91-20-3	Naphthalene	ND	10
88-74-4	2-Nitroaniline	ND	50
99-09-2	3-Nitroaniline	ND	50
100-01-6	4-Nitroaniline	ND	50
98-95-3	Nitrobenzene	ND	10
88-75-5	2-Nitrophenol	ND	10
100-02-7	4-Nitrophenol	ND	50
86-30-6	N-Nitrosodiphenylamine	ND	10
621-64-7	N-Nitrosodipropylamine	ND	10
87-86-5	Pentachlorophenol	ND	50
85-01-8	Phenanthrene	ND	10
108-95-2	Phenol	ND	10
129-00-0	Pyrene	ND	10
120-82-1	1,2,4-Trichlorobenzene	ND	10
95-95-4	2,4,5-Trichlorophenol	ND	50
88-06-2	2,4,6-Trichlorophenol	ND	10

D.L. = Detection Limit
ND = Not detected

SCS ANALYTICAL LABORATORY
2960 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-0334
FAX (213) 595-6705

Sample I.D.: Water Bore Out
Date Received: 12/17/90
Date Analyzed: 12/24/90
Matrix: water
Project: 0689044
File #: tally26.rep

Compound	EPA Number	Result -----mg/L	D.L (ppm)-----
Arsenic	206.2	ND	0.02
Barium	200.7	ND	0.1
Cadmium	200.7	ND	0.2
Chromium	200.7	ND	0.05
Lead	200.7	ND	0.5
Mercury	245.1	ND	0.002
Selenium	270.2	ND	0.01
Silver	200.7	ND	0.05

ND = Not Detected
D.L. = Detection Limit

APPENDIX D

RESUMES OF SAMPLING AND ANALYTICAL PERSONNEL

D-1. BASIN & RANGE HYDROGEOLOGISTS, INC.

BASIN & RANGE
HYDROGEOLOGISTS
AN ARIZONA CORPORATION

RESUME

DAVID L. KIRCHNER

Mr. David L. Kirchner, founder of BASIN & RANGE HYDROGEOLOGISTS, INC., received his *Bachelor of Science in Geology* from the University of Texas, at Austin. He continued his academic training at the University of Wisconsin, at Madison, and the University of Missouri, at Rolla, where he received additional instruction in hydrogeology and ground-water sciences. Mr. Kirchner has worked continuously in the private consulting business for 17 years and gained his professional, technical experience predominantly in the Western and Southwestern United States.

Mr. Kirchner has managed complex and politically sensitive, hydrogeological and environmental projects in Arizona (ENSCO Hazardous Waste Management Facility), Alaska (the Trans-Alaskan Pipeline) and Northern Africa (water supply for a proposed Chevron Oil Company Petroleum storage and shipping facility along the Red Sea in the Democratic Republic of Sudan). He has conducted numerous environmental site assessments and hydrogeological investigations and evaluated severely contaminated soil and ground-water sites throughout Arizona, California, Utah, Nevada and the Southwest.

Mr. Kirchner provides technical environmental consultation for private-sector clients, including industrial and electronics manufacturers, waste management firms, petroleum refiners and distributors, water providers, real estate developers, financial institutions, property managers, brokers, land owners, and environmental and water attorneys. Mr. Kirchner has extensive experience in hydrogeological, water resources management, and site characterization activities. He was retained as a consulting hydrogeologist to ENSCO for designing, building and permitting the former proposed Arizona Hazardous Waste Management Facility near Mobile. He participated in development of the Facility's water supply, hydrogeologic characterization of the site, development of a ground-water sampling and monitoring system, and assisted with the preparation of the Part-B RCRA environmental permit application. Mr. Kirchner is knowledgeable of the pertinent federal and state environmental regulations, and frequently participates in continuing education seminars.

Mr. Kirchner is active in civic and professional societies involved in environmental matters. Recently he served on Governor Rose Mofford's Hazardous Waste Technical Advisory Committee. He founded a new company called the Risk Aversion Group (RAG) which offers an educational program for environmental professionals who require professional liability insurance (errors & omissions). He was appointed by Governor Symington to serve a six-year term as a commissioner for the Commission on the Arizona Environment. He practices as a Certified Professional Geologist through the American Institute of Professional Geologists, a national organization, and is a co-founder and past president of the Arizona Hydrological Society, a not-for-profit, professional organization with over 300 members and three State chapters. He is past president of the Arizona State Section of the American Water Resources Association and is a member of the executive committee of Arizona's State Laboratory's Environmental Laboratory Advisory Committee. Mr. Kirchner also is involved with other professional organizations including the HAZWaste Society, the Association of Engineering Geologists, the American Geophysical Union, the Arizona Riparian Council, the Arizona Water and Pollution Control Federation, and the Environmental and Natural Resources Section of the Arizona State Bar. Additionally, he founded The Arizona Aquifer Protection Association (TAAPA).

5080 NORTH 40TH STREET, SUITE 105 PHOENIX, ARIZONA 85018 TELEPHONE (602) 840-3333 TELEFAX (602) 840-8011

BASIN & RANGE HYDROGEOLOGISTS
AN ARIZONA CORPORATION

RESUME

MARK A. SHELLHORN

Mr. Mark A. Shellhorn is a Principal with BASIN & RANGE HYDROGEOLOGISTS, INC. He received his *Bachelor of Science* degree in geology and mineralogy from The Ohio State University, and his *Master of Science* degree in geochemistry and geology from the New Mexico Institute of Mining and Technology. Since leaving New Mexico, Mr. Shellhorn continued his academic training in hydrogeology through instruction at The Pennsylvania State University and Colorado School of Mines. He has worked continuously in major industry and private consulting for nine years, with national and international experience.

Prior to moving to Arizona, Mr. Shellhorn served as a research geochemist pioneering new technologies in the field of bioremediation for the mining industry. In this capacity, he interfaced with industry, federal and state governments, and the public and served as a federal and state government lobbyist dealing with nationwide environmental concerns. He coordinated demonstration programs designed to evaluate new technologies for soil and ground-water remediation, with the objective of establishing alternative "Best Available Technologies (BAT)" for the industry. He lectured and authored extensively on those topics, and served on several state committees organized to review and advise on environmental regulations and pending legislation.

Mr. Shellhorn is active in a diverse field of environmental matters. He practices as a professional geologist under the authority of the Arizona Board of Technical Registration, the California Board of Technical Registration, and as a Certified Professional Geologist through the American Institute of Professional Geologists (a national organization). Mr. Shellhorn serves as a working group member with the Arizona State Laboratory Environmental Advisory Committee which was organized to draft rules for the licensure of environmental laboratories involved in compliance testing under existing state and federal regulatory programs. Mr. Shellhorn is also involved with other organizations including: the American Geophysical Union, the Geological Society of America, the Association of Ground-water Scientists and Engineers, the National Water Well Association, the Arizona Hydrological Society, and The Arizona Aquifer Protection Association (TAAPA).

He provides technical and environmental management services for private-sector clients including specialized manufacturing firms, petroleum refiners and distributors, water service companies, land developers, real estate brokers, lending institutions, risk management companies, and law firms specializing in environmental matters. He has extensive knowledge in geology, contaminant hydrogeochemistry, hazardous waste investigations and remedial design and implementation. Mr. Shellhorn provides expert testimony and consultation for private sector clients and their legal counsel in those disciplines, and negotiates with state and federal environmental agencies on behalf of B&RH's clients. Mr. Shellhorn is knowledgeable of pertinent environmental regulations, and regularly participates in continuing education programs.

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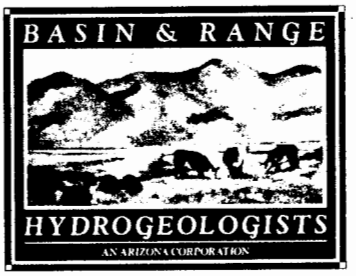

RESUME

PHILIP J. LAGAS

Mr. Philip J. Lagas is an Associate with BASIN & RANGE HYDROGEOLOGISTS, INC. He received his degrees of *Bachelor of Science in Environmental Sciences and Resource Management* and *Master of Science in Geological Sciences* from Lehigh University. Since leaving the University, Mr. Lagas has continued his academic training in hydrogeology and hazardous waste management through regular participation in continuing education programs.

Mr. Lagas has worked in private consulting for eight years, managing multi-disciplinary waste management and environmental projects, including site assessments, remedial investigations/feasibility studies, Resource Conservation and Recovery Act (RCRA) permitting and compliance assessments, and remedial design/implementation. He served as a geologist on a United States Department of Energy project investigating the hydrogeology of candidate sites for high- and low-level nuclear waste repositories. Mr. Lagas was responsible for compiling and interpreting information concerning lithologic and engineering properties of site geologic units, Quaternary faulting and seismicity, and surface and ground-water hydrology, and evaluating potential pathways for radionuclide migration. He also participated in nationwide public information meetings sponsored by the United States Department of Energy.

As a consultant to the State of Arizona, Mr. Lagas recently directed Water Quality Assurance Revolving Fund remedial response activities for the Department of Environmental Quality. Those activities included facility surveys and inspections; characterizing the extent of alleged ground-water contamination; developing and implementing soil, soil gas, and ground-water sampling plans; assessing alternative technologies for remedial action; and preparing Remedial Action Plans. He also was responsible for implementing quality assurance/quality control and health and safety programs, coordinating technical resources and subcontractors, client and regulatory agency liaison, and project finance and schedule control.

Mr. Lagas provides technical and environmental management services for commercial and industrial clients throughout the Southwest. He performs site assessments and environmental audits to evaluate technical compliance with federal, state, and local hazardous waste regulations, participates in negotiations with federal and state environmental agencies on behalf of B&RH's clients, and provides expert testimony. He has developed waste handling and analysis procedures, contingency plans, closure/post-closure plans, and applications for RCRA Part B, air emissions, and aquifer protection permits. Mr. Lagas also has managed soil and ground-water remediation programs and has worked with facility owners and operators to develop cost-effective and technically feasible waste minimization strategies.

Mr. Lagas is knowledgeable of pertinent environmental regulations and, as a member of the Environmental Committee of the Arizona Association of Industries (AAI), reviews and provides technical comments on new environmental laws proposed by the Arizona legislature. He assists AAI with preparation of information circulars and conducts educational presentations for interested members of the industrial community. He also is involved with professional organizations including the Arizona Hydrological Society (AHS), the HAZWaste Society, The Arizona Aquifer Protection Association (TAAPA), and the Geological Society of America (GSA).

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BASIN & RANGE HYDROGEOLOGISTS
AN ARIZONA CORPORATION

RESUME

KATHLEEN D. KIRCHNER

Ms. Kathleen D. Kirchner is an Associate at BASIN & RANGE HYDROGEOLOGISTS, INC. She received her Bachelor of Science in Geology from Northern Arizona University and completed subsequent training in ground-water hydrology at Northern Arizona University. She has worked continuously in federal government and private consulting for twelve years, with most of her work being performed in Arizona.

Prior to moving to Phoenix, Arizona, Ms. Kirchner served as a geologist for the U.S. Geological Survey, where she gained experience in geological field mapping and interpretation and encoding of geologic maps to compile a computer data file identifying geologic features throughout the United States.

Since moving to Phoenix in 1984, Ms. Kirchner has become very active in professional societies involved in water resources and environmental matters. She practices as a Certified Professional Geologist through the American Institute of Professional Geologists, a national organization. She is a Board of Director and past president of the Arizona Hydrological Society, a not-for-profit, professional organization having over 300 members and three State chapters. Ms. Kirchner is also involved with other professional organizations including the HAZWaste Society, The Arizona Aquifer Protection Association (TAAPA), and Geological Society of America.

Ms. Kirchner provides technical environmental consultation for private-sector clients, including industrial and electronics manufacturers, waste management firms, petroleum refiners and distributors, water providers, real estate developers, financial institutions, property managers, brokers, land owners, and environmental and water attorneys. Ms. Kirchner has been responsible for project management and technical assistance in a variety of hydrogeological investigations. Her experience includes acquisition of geological and hydrogeological data as well as data analysis and preparation of reports. Specifically, Ms. Kirchner managed three of the Arizona Department of Environmental Quality's (ADEQ's) Water Quality Assurance Revolving Fund (WQARF) (State Superfund) projects. Each project involved extensive data collection and analysis tasks, culminating in a summary report.

Additionally, Ms. Kirchner provided technical assistance to ENSCO during the conduct of the hydrogeological site characterization task at the Arizona hazardous waste management facility near Mobile, Arizona. Geological and hydrogeological data were obtained to evaluate the characteristics of the vadose zone and aquifer beneath the site. Those data were utilized during preparation of the Resource Conservation and Recovery Act (RCRA) Part B permit application.

Ms. Kirchner has developed and implemented numerous field programs involving exploratory drilling and sampling as well as installation of ground-water monitoring wells. She is familiar with several of the drilling techniques which are utilized during exploratory, subsurface investigations. Ms. Kirchner has also performed soil and ground-water quality sampling in accordance with U.S. Environmental Protection Agency (EPA) procedures. She is knowledgeable of the pertinent federal and state environmental regulations and frequently participates in continuing education seminars.

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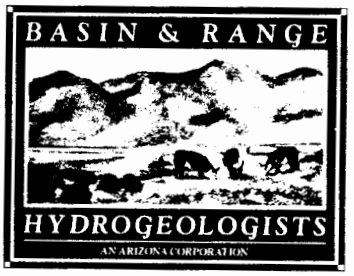

RESUME

TRACEY S. MOORE

Ms. Tracey S. Moore is an Associate at BASIN & RANGE HYDROGEOLOGISTS, INC. (B&RH). She received her degree of *Bachelor of Science in Geology* from California State University, Fullerton. In addition, Ms. Moore completed academic training in hydrogeology and hydrology while pursuing her degree.

Ms. Moore has worked in private consulting for five and a half years, providing technical assistance and project management in a variety of geologic and hydrogeologic investigations. Her experience includes ground-water and soil contamination investigations, underground storage tank assessments, environmental assessments in support of real-estate transactions, ground-water quality sampling and reporting, coordination of contract laboratories and field support services, supervision of subsurface drilling and monitoring well construction, litigation support, management of near-surface soil sampling and application of those findings towards health-risk assessments which satisfy California Proposition 65 requirements.

Prior to moving to Arizona, Ms. Moore served as a research geochemist for the Petroleum Inorganic Geochemistry Section of Chevron Oil Field Research Company for two years. In that capacity, she collected samples of oil field brines from off-shore platforms and conducted analyses of those samples in temporary laboratories, onshore. While in this position, Ms. Moore also conducted research into the boron content of pore water in the Monterey Formation of California. She also has worked as a water chemist for a private laboratory where she conducted varied analyses of water and wastewater samples.

Additionally, Ms. Moore provided technical assistance during remedial response activities for the Arizona Department of Environmental Quality under the Water Quality Assurance Revolving Fund (WQARF). Her technical support included facility surveys, historical records review and data collection, soil and ground-water quality sampling, graphical representation of data for evaluation and assessment of potential sources of contaminants, development and implementation of a questionnaire to inventory chemical usage at industrial sites located in four Phase I WQARF study areas, and the incorporation of responses from those questionnaires into a comprehensive database for reporting purposes.

Ms. Moore is providing technical assistance to the Western Area Power Administration during the conduct of an assessment of five substations in Arizona. That assessment included collection of 1,100 wipe and soil samples which were analyzed for polychlorinated biphenyls. Ms. Moore is responsible for compilation of laboratory data, coordination of graphical presentation of results, preparation of summary reports, as well as sampling plans for subsequent phases of investigation.

Ms. Moore is an active member of the Arizona Hydrological Society, a not-for-profit professional organization. She is the Editor of the Society's newsletter and has also served as AHS's Secretary/Treasurer.

BASIN & RANGE HYDROGEOLOGISTS
AN ARIZONA CORPORATION

RESUME

C. LEE MORRIS

Mr. C. Lee Morris is an Associate at BASIN & RANGE HYDROGEOLOGISTS, INC. (B&RH). He received a *Bachelor of Science in Geology* and a *Bachelor of Science in Business* from Eastern Illinois University in Charleston, Illinois. He is currently working towards his *Master's Degree in Business Administration.* Mr. Morris has continued his technical education through short courses and seminars dealing with environmental and ground-water related issues. He has completed 24 hours of Health & Safety Training and is certified for category D (SCBA) respirator use.

Mr. Morris is responsible for conducting hydrogeological and environmental investigations for B&RH. He performs literature searches, data collection analysis tasks, and report preparation. Various field assignments include underground storage tank removal activities, supervision of drilling and excavation contractors, hazardous waste, and soil and ground-water sampling. Mr. Morris has extensive polychlorinated biphenyl sampling experience and is familiar with U.S. Environmental Protection Agency (EPA) sampling methodologies and procedures.

Before joining B&RH, Mr. Morris implemented ground-water monitoring programs for a major Arizona utility. He has performed soil and ground-water quality sampling in accordance with U.S. EPA procedures and is familiar with drilling techniques utilized during exploratory, subsurface investigations.

Prior to moving to Arizona in 1990, Mr. Morris served as a Geologist for the State of Illinois. In that capacity, he performed investigations of contaminated ground water by oil and oil-field brine. Mr. Morris was a member of an interagency coordinating committee responsible for the implementation of the Illinois Groundwater Protection Act. He has worked with the Illinois EPA and the U.S. EPA on program development and implementation in ground-water issues. Through his work with government entities on the Federal, State, and local level, Mr. Morris had developed a fundamental knowledge and understanding of the regulatory framework and its interaction with the private sector. He is a member of the National Water Well Association and the Arizona Hydrological Society.

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BASIN & RANGE HYDROGEOLOGISTS
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RESUME

ERIC J. ZUGAY

Mr. Eric J. Zugay serves as a technical aide for BASIN & RANGE HYDROGEOLOGISTS, INC. (B&RH) while actively pursuing his degree in geology at Arizona State University (ASU). Mr. Zugay assists B&RH with technical research, field investigative work, geological data analysis, and report preparation. He is also responsible for categorizing B&RH's technical library, maps, aerial photos, and geologic maps and reports.

One of Mr. Zugay's responsibilities is "*graphics illustrating*" using the B&RH computer-aided drafting capabilities. Mr. Zugay constructs exhibits to portray site and sample locations, and other important features in support of B&RH's environmental assessment reports. Mr. Zugay converts field notes into scaled drawings, and translates existing data into a pictoral analysis; for example, locating wells, using environmental laboratory data to construct water-quality diagrams, or using borehole logs to show geologic structures. Mr. Zugay also has a special talent for devising three-dimensional diagrams and cross-sections that clarify depths of boreholes, geologic structures, or extent of contamination.

Mr. Zugay helps perform research on various hydrogeologic and geologic topics, such as subsidence, water well registration, ground-water contamination, artificial recharge and bioremediation projects. Mr. Zugay conducts research at state agencies, such as the Arizona Department of Environmental Quality, the Arizona Department of Water Resources, and ASU libraries.

Mr. Zugay assists B&RH and its clients with soil and ground-water sampling using various EPA-approved methods, and log book and field map preparation. He provides assistance with B&RH drilling activities and soil and ground-water monitoring projects. His experience with underground storage tank assessments include delineation of soil contamination and removal. Mr. Zugay has performed random soil sampling as mandated by EPA guidelines, using random-number tables and the formation of grids. Mr. Zugay also has experience using field equipment, such as organic vapor monitoring meters and audio/visual recording equipment. Mr. Zugay edits and improves the quality of audio/visual tapes by using B&RH's audio/visual recording equipment in conjunction with B&RH's sophisticated video cassette recorder. As required by the Occupational Safety and Health Administration (OSHA), Mr. Zugay has completed the 40-hour initial training requirement for Hazardous Waste Operations and Emergency response. Mr. Zugay completed the initial training in March, 1991.

Mr. Zugay recently completed a graduate-level course at ASU entitled "*Ground-water Hydrology*," where he was instructed and subsequently tested to successfully demonstrate his understanding of ground-water flow theory and application of aquifer testing. Drilling methods and various types of ground-water exploration equipment were reviewed and included discussions regarding their application in ground-water contamination investigations.

Mr. Zugay is a member of the Arizona Hydrological Society, an organization that conducts seminars and symposia covering such topics as ground-water modeling, contamination, and Arizona geology.

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D-2. TURNER/CAS LABORATORIES

TURNER/CAS
LABORATORIES INC.

NANCY D. TURNER

EDUCATION

University of Phoenix, BS Business Administration, 1982
University of Arizona, College of Nursing, 1967-1969
University of Arizona, College of Business Administration, 1964-1966

PROFESSIONAL HISTORY

Turner/CAS Laboratories, Inc., President, 1990
Turner Laboratories, Owner/Operator, 1984-1990
Analytical Technologies, Inc., National Marketing Manager, 1984-1988 EFCO Laboratories/Arizona Feeds, Manager/Assistant Manager, 1970-1983

REPRESENTATIVE EXPERIENCE

Ms. Turner is President and Chairman of the Board of Turner/CAS Laboratories, Inc. Ms. Turner is responsible for all aspects of laboratory operations including marketing, client development and project management, employee supervision and quality assurance.

Ms. Turner has extensive marketing experience that includes bid preparation, sales presentations, seminar development and project management. Project management activities involve sample logistics, report verification and liaison between client and laboratory.

AFFILIATIONS

Southern Arizona Environmental Management Society, Past President Arizona Association of Laboratories, Co-Founder, 1980, President Arizona Institute of Mining Engineers
Arizona Hydrogeology Society
Standing member of ADHS Laboratory Advisory Council

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W. W. "WOODY" TURNER

EDUCATION

Fresno State College, B.S. Chemistry, 1960

PROFESSIONAL HISTORY

Turner/CAS Laboratories, Inc., Vice-President, 1990 - present Turner Laboratories, Owner/Operator, 1984 - 1990
Fluid Systems, U.O.P., Inc., Process Engineer, 1982-1983
Mineral Sciences, U.O.P., Inc., Chief Chemist, 1979-1982
EFCO Laboratories, Manager and Chief Chemist, 1964-1979

REPRESENTATIVE EXPERIENCE

Thirty years experience in laboratory management. Founded Turner Laboratories in March of 1984.

Process engineer for Fluid Systems, U.O.P., Inc. of San Diego, CA. Responsibilties included pilot plant management for reverse osmosis treatment systems. Developed membranes for brackish and seawater desalinization.

Hazardous waste manager for Mineral Sciences Division of U.O.P., Inc. Responsibilites included coordinating with world wide operations managers and corporate headquarters in Des Plaines, Illinois.

Served on numerous committees for the American Oil Chemists' Society including the atomic absorption spectroscopy subcommittee. Chaired a number of seminars dedicated to atomic absorption.

Manager of EFCO Laboratories for fifteen years. Worked closely with the City of Tucson and University of Arizona College of Medicine to provide water quality analysis for their treatment plants.

AFFILIATIONS

Society of Applied Spectroscopy
American Oil Chemists' Society
Southern Arizona Environmental Management Society
Arizona Association of Laboratories

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TURNER/CAS
LABORATORIES INC.

THOMAS M. GRAF

EDUCATION

University of Arizona: B.S. Geoscience, 1977

PROFESSIONAL HISTORY

Turner/CAS Laboratories, Inc., Laboratory Manager, 1990
Turner Laboratories, Organic Lab Manager, 1989 - 1990
Analytical Technologies, Inc., Environmental Laboratory, 1986 - 1989
Kocide Chemical, 1982 - 1985
The Bunker Hill Company, 1981 - 1982
Magma Copper Company, 1979 - 1981
Cyprus Metallurigical Processes Corp., 1978 - 1979

REPRESENTATIVE EXPERIENCE

Mr. Graf joined Turner Laboratories as Laboratory Manager in August, 1989. His responsibilities include management of all personnel, data review and quality assurance oversight.

Mr. Graf has extensive knowledge of the analysis of volatiles in soils, air and water with gas chromatography. He has a working knowledge of ion chromatography, atomic absorption spectrophotometry and gas chromatography/mass spectrometry.

While employed by the mining industry Mr. Graf has worked in a quality control environment testing metal and metal alloys for purity and alloy composition.

Mr. Graf was a key member in the development and construction of a solvent extraction-crystallization plant producing 7,000 tons per year copper sulfate pentahydrate.

AFFILIATIONS

PHI THETA KAPPA Honor Society
American Chemical Society
Southern Arizona Environemental Management Society

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TURNER/CAS
LABORATORIES INC.

MARIANNE J. HESTER

EDUCATION

ABC Technical and Trade School, 1983-1985

PROFESSIONAL HISTORY

Turner/CAS Laboratories, Inc., Inorganic Chemist, 1990
Hughes Aircraft, Electronic Tester, 1985-1988 Skyline Labs, Geological Atomic Absorption Operator, 1981-1985

REPRESENTATIVE EXPERIENCE

As a chemist at Ansell Inc., a manufacturer of latex examination and surgical gloves, Ms. Hester collected hourly samples from dip tanks on the line. She performed nitrate, carbonate, and peroxide levels by titration and percent solids of latex. Ms. Hester was also responsible for tensile testing-phenol distillation and chemical testing new shipments of products used in manufacturing. She transferred to microbiology after five months and performed growth inhibition, an growth promotion testing in batch samples. Performed same testing on newly received supplies.

Ms. Hester joined Turner/CAS in September, 1990. Her responsibilities include metal analyses by flame, cold vapor and graphite furnace atomic absorption spectroscopy. Also responsible for all QA/QC required to support metal analysis. These analysis include total digestion, TCLP procedures and EP Toxicity. Ms. Hester supervises two technicians in addition to her other responsibilities.

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